# FINAL REPORT

# ON THE

# INVESTIGATION INTO THE

# GRAND COULEE FIRE

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## EXECUTIVE SUMMARY

At approximately 5:00 p.m. on Wednesday, November 20, 1991, a fire occurred at a warehouse located south and west of Grand Coulee. The warehouse was being used as a transfer facility as part of the province's Agricultural Chemical Collection Program (ACCP) and contained a variety of waste agricultural chemicals. In addition, a smaller quantity of waste laboratory chemicals were at the facility.

Emergency response to the fire was provided by the Grand Coulee Fire Department, the RCMP, and the Regina City Fire Department. Also on site were representatives from Saskatchewan Environment and Public Safety, the provincial Fire Commissioner's Office, the provincial Emergency Measures Organization (EMO), SPMC, and the owner of the facility. Due to the nature of the facility the decision was made to allow the fire to burn. By approximately 11:00 p.m. that evening the fire had burned itself out.

At a news conference on November 21, 1991, the Honourable Carol Carson (Minister of Environment and Public Safety and Community Services), announced that she had appointed Randy Sentis, Assistant Deputy Minister of Saskatchewan Environment and Public Safety, and Rick McCullough, provincial Fire Commissioner to head up an inquiry into the fire.

The Minister directed her officials to:

- Determine what happened, how the fire started, what was in the warehouse, and how efficiently the emergency response system worked.
- Conduct an environmental assessment of the damage which may have been done, short term and long term, as a result of the fire.
- Evaluate the Agricultural Chemical Collection Program to see if the collection, transportation and storage of waste chemicals is being done in the best possible manner.
- Make any recommendations for future control procedures which might be useful to ensure such a situation does not arise again.

An interim report on the investigation was released on November 29, 1991. Copies of this report are available from the Department.

This report reviews the Fire Commissioner's Investigation, the additional environmental investigations, the cleanup program, and the report of the independent investigation into the Agricultural Chemical Collection Program.

The environmental investigation determined that no toxins, be they pesticides, pesticide breakdown products or pesticide combustion products or any other chemicals attributable to the fire were present at the downwind residences.

As well, the investigation indicated that herbicides were found in small concentrations (2,4-D at 20 ppb) at only one location within snow samples. All other instances show that no detectable phenoxy-acid herbicides or organochlorine insecticides were present within snow downwind from the fire site.

Bioassay analysis of soil samples collected both at control locations and from the downwind transects all showed that no toxic components were present within the soils following the Grand Coulee fire.

The results of the investigation and sample bioassay analysis indicate that no detectable toxic components were present on the ice or snow of downwind water supply reservoirs shortly after the Grand Coulee fire.

The Fire Commissioner's investigation concluded that, "It is possible this was an accidental fire with the point of origin being near the wall in the north east corner of the south section. Research by the investigators, heavy black smoke observed coming from the eaves and the firefighter locating a hot spot on the wall, supports the possible ignition of exposed polyurethane foam insulation in this area. The ignition may have been caused by overheated electrical wires.

**However, due to the lack of factual information the cause of this fire is listed as undetermined."**

Clean-up activities at the site included removal and disposal of contaminated soil, demolition and disposal of the building structure, packaging and shipment of surviving chemicals, packaging and disposal of ash and small debris, remediation of the adjacent storage shed and collection and treatment of a small volume of contaminated snow-melt. The pressing site clean-up and containment was successfully completed by December 17, 1991 and the remainder of the associated waste shipment or treatment being completed by late March, 1992.

The results of various analyses performed both immediately after the fire or during the clean-up of the Grand Coulee transfer site were valuable in determining the degree of contamination and the appropriate disposal mechanism for the remnants of the former operation. Analysis of soil samples showed that contamination was confined to an area immediately to the south-east of the former structure and that clean-up measures employed to deal with these residues were effective.

Monitoring of soils in the affected areas is recommended to reconfirm the adequacy of clean-up and previous monitoring results. The only remaining component of the clean-up of the structure to be addressed is a final treatment of the concrete floor and foundation to remove or destroy any remaining surface contamination. It is recommended that this work be performed as soon as spring weather permits.

The Department entered into an agreement with William Neff of William A. Neff Consulting Inc. of Ottawa to carry out the independent study of the agricultural chemical collection program. Mr. Neff has had a wide range of experience including five and a half years as Division Chief, Petroleum and Organic Chemicals, Environmental Protection Division, Environment Canada and twelve years as Vice-President, Technical Affairs of the Canadian Chemical Producers Association. Mr. Neff is a graduate of the University of Saskatchewan (1959) with a degree in Chemical Engineering.

Mr. Neff's study was received by the Department in early March, 1991. The main conclusion of the Report was, "The Agricultural Chemical and Institutional Chemical Collection Programs are worthwhile and meet a demonstrated environmental need." However, the Report raised a number of concerns related to policy considerations and operational details.

The following are the recommendations contained in the final report.

1. **It is recommended that the Province adopt and enforce the National Fire Code of Canada.**

2. The National Fire Code addresses the importance of environmental issues and safety standards underlying the use of special facilities for both the storage and transfer of new and used chemicals and hazardous substances including wastes and flammable materials. **It is recommended that the location of such sites be established in accordance with set criteria with consideration for risk to people, property and the environment.** This should be done in consultation with Saskatchewan Environment and Public Safety. As well the Crop Protection Institute of Canada Warehousing Standards provides recommendations for siting such facilities which can be used as guidelines. These facilities must also be constructed and maintained in accordance with **The National Building Code of Canada.** Plans for new facilities and alterations to existing facilities should be approved by the authority having jurisdiction and submitted to the Fire Commissioner for review.

3. **Saskatchewan Environment and Public Safety should develop a long term strategy to deal with waste pesticides, institutional and household wastes. This must be done as part of the development of an overall waste management strategy for the province which should be initiated as soon as possible.**

4. **It is recommended that the existing Hazardous Substances Regulations be amended immediately to include the storage and safe disposal of hazardous wastes.**

5. **The Agricultural Chemical Collection Program and the Institutional Chemical Collection Program should be maintained, however, the programs should be deferred for at least one year to allow for a suitable site to be selected and developed.** It should be noted that a new site will have to satisfy the requirements of the Environmental Assessment Act as well as all regulations applicable to hazardous wastes.

6. **Saskatchewan Environment and Public Safety should review its present relationship to these chemical collection programs.** Any involvement in the future should be as the regulator and not as the program manager. At the same time, the Department should also review the funding of these programs with a view to recovering the costs from the users of the chemicals.

7. **It is recommended that a provincial emergency response team be established to deal with incidents of similar nature in the future.** This would require initial and ongoing training for the response team, supported with equipment that would allow them to respond to a variety of incidents. It is recommended this training be provided in accordance with NFPA 471 Recommended Practice for Responding to Hazardous Materials Incidents. This standard outlines the minimum requirements for dealing with responses to hazardous materials incidents and provides specific operating guidelines.

8. It is recommended that all levels of government: federal, provincial, and municipal, work together with industry and organizations such as MIACC (Major Industrial Accident Coordination Committee) to strengthen relationships and ensure the most effective response is provided when needed. **It is further recommended that the province establish a provincial coordinating committee to develop response plans and procedures for effective emergency response.**

9. **It is also recommended that the Government of Saskatchewan develop its own emergency response communication strategy to deliver and provide information when incidents similar to this one involve government departments.** The control and planned release of accurate information is very important. This was very effective in the days following the incident however the process on the day of the incident appeared inadequate.

   **The feasibility of an emergency 1-800 number or province wide 911 system should be investigated.** This would allow for the notification of all agencies and personnel who have a response role or a vested interest in an incident of any nature.

10. **It is recommended that training be made available to all emergency responders who could be called upon to deal with hazardous materials incidents.** This training should meet as a minimum the requirements outlined in the National Fire Protection Association Standard 472, Professional Competence of Responders to Hazardous Material Incidents.

11. **It is recommended that the local authority having jurisdiction, must ensure these facilities are inspected regularly and all codes are enforced.** All locations, where dangerous goods are stored, must be identified and response plans provided to the local fire department. This will provide the **"Right to Know"** for members of the community as well as support preparation of the overall community response plan. It is recommended that an inventory of all hazardous material sites be established and that regular inspection cycles be maintained. Response plans must be provided to the local fire department in accordance with The National Fire Code. It should be the role of the Provincial Fire Commissioner's Office to audit inspections of these facilities.

12. Restricted access to and from hazardous material sites and security of products stored there is critical to the safe operation of such facilities. **It is recommended that physical security, including locks, fences and access and inventory control be maintained at all hazardous material storage locations.**

13. The Crop Protection Institute of Canada has developed "Warehousing Standards" for the storage of crop protection products for agricultural use and storage of pesticides for industrial use. **It is recommended that all facilities be constructed, managed and operated in accordance with these standards or equivalent provincial standards.**

14. **The process of bulking liquid pesticide wastes should be discontinued until such time as written criteria are established which have been independently reviewed and accepted.**

15. **The Saskatchewan Emergency Measures Organization should assist communities such as Grand Coulee develop and implement an emergency response plan.** These plans should include a communication strategy that would ensure the notification of residents and the safety of all responders and should be tested on an annual basis.

16. **It is recommended that further monitoring of soils in the affected areas be completed to confirm previous monitoring results.**

17. **It is recommended that a final treatment of the foundation and floor area be completed as soon as possible and the adequacy of the treatment be confirmed by monitoring.**

## 1.0 INTRODUCTION

1.1 At approximately 5:00 p.m. on Wednesday, November 20, 1991, a fire occurred at a warehouse located south and west of Grand Coulee. The warehouse was being used as a transfer facility as part of the province's Agricultural Chemical Collection Program (ACCP) and contained a variety of waste agricultural chemicals. In addition, a smaller quantity of waste laboratory chemicals were at the facility.

1.2 Emergency response to the fire was provided by the Grand Coulee Fire Department, the RCMP, and the Regina City Fire Department. Also on site were representatives from Saskatchewan Environment and Public Safety, the provincial Fire Commissioner's Office, the provincial Emergency Measures Organization (EMO), SPMC, and the owner of the facility. Due to the nature of the facility the decision was made to allow the fire to burn. By approximately 11:00 p.m. that evening the fire had burned itself out.

1.3 At a news conference on November 21, 1991, the Honourable Carol Carson (Minister of Environment and Public Safety and Community Services), announced that she had appointed Randy Sentis, Assistant Deputy Minister of Saskatchewan Environment and Public Safety, and Rick McCullough, provincial Fire Commissioner to head up an inquiry into the fire.

The Minister directed her officials to:

- Determine what happened, how the fire started, what was in the warehouse, and how efficiently the emergency response system worked.
- Conduct an environmental assessment of the damage which may have been done, short term and long term, as a result of the fire.
- Evaluate the Agricultural Chemical Collection Program to see if the collection, transportation and storage of waste chemicals is being done in the best possible manner.
- Make any recommendations for future control procedures which might be useful to ensure such a situation does not arise again.

1.4 An interim report on the investigation was released on November 29, 1991. Copies of this report are available from the Department.

1.5 This report reviews the Fire Commissioner's Investigation, the additional environmental investigations, the cleanup program, the report of the independent investigation into the Agricultural Chemical Collection Program and contains a number of recommendations on changes required to reduce the risk of future incidents of this nature. It should be noted that Section 7.0 includes all of the recommendations that appear in the report as well as any other recommendations that came out of the overall investigation.

## 2.0 EMERGENCY RESPONSE

At 1718 hours on November 20, 1991, the Grand Coulee Volunteer Fire Department received a call to a farm located 1/4 mile southwest of town. The initial alarm indicated smoke was coming from the building used as an agricultural chemical collection and transfer facility by Saskatchewan Department of Environment and Public Safety.

The Grand Coulee Fire Department was on the scene by 1725 hours. Initial assessment of the situation was made by the local Fire Chief Maurice Revet. His knowledge of the structure and the materials stored in the building led to a decision to allow the fire to burn freely. Many of the chemicals stored in this building were reactive to water and the application of water would intensify rather than extinguish the fire. In addition, the application of water could cause further migration of contamination from the original site. This would result in a much larger and more difficult cleanup situation. Perhaps the most significant result from allowing the fire to burn freely, was the near complete combustion of those chemicals that became involved in fire.

One member of the Grand Coulee Fire Department arrived on the scene at 1725 with a cellular phone. Under the direction of the local fire chief, calls were placed to outside agencies for mutual aid. The Regina Fire Department was notified and provided an immediate response arriving on the scene at 1810 hours. They agreed allowing the fire to burn was the proper decision. A

command post was established upwind of the burning building, while a communication centre was set up at the Grand Coulee School. The school also served as a focal point for the media where public information releases were handled. The RCMP were contacted at 1745 hours and worked quickly to provide security and carry out subsequent decisions to evacuate farm residents downwind and reroute traffic on the Trans Canada Highway. Contacts were also made with Saskatchewan Emergency Measures Organization and Regina "911" at this time.

The fire was also reported to the Saskatchewan Environment Spill Report Centre by the property owner. This resulted in the dispatch of representatives from the Department of Saskatchewan Environment and Public Safety. While enroute, they also contacted the Regina Fire Department, Saskatchewan Emergency Measures Organization and other co-workers. They arrived on the scene shortly after 1800 hours and provided a list of building contents to the Fire Chief. These people had been in the building earlier in the day and had a current inventory and location of the building contents. Again, the decision not to extinguish the fire was reinforced. The Fire Commissioner's Office was contacted by Regina 911 Dispatch and a representative was on site by 1925 hours. A representative from the Saskatchewan Property Management Corporation was also on the scene at this time.

The fire was allowed to burn and was reduced to a smouldering stage by 2200 hours. Based on an updated weather forecast a precautionary evacuation of the town was ordered by the Mayor of Grand Coulee at 2145 hours. This forecast was later revised and residents were allowed to return home around midnight.

## 2.1 CONCLUSION

The Town of Grand Coulee did not have a formal emergency response plan in place to deal with emergencies of this nature. However, initial actions, resulting in no injuries or loss of life, indicated some informal preplanning had occurred. The local fire department was aware this facility could present a particular hazard should a fire occur and discussion how it would be handled had previously taken place. The quick response, initial size up and immediate action, prevented any injury or loss of life to both response personnel and people in the area. In general, the response by emergency personnel was effective yet, the need for a well established emergency plan was apparent.
As already pointed out, the community of Grand Coulee did not have a formal emergency response plan. Through a combination of good management and good fortune the consequences of a major disaster resulting from this incident were averted.

Planning is an essential part of emergency preparedness. The development of a community response plan is imperative to the successful mitigation of any

emergency and for the subsequent return of conditions within the community to normal or near normal.

The first step in the planning process is to identify the hazards that pose a risk to the community. It is impossible to eliminate all risk but by taking certain precautions the effect of an accident can be minimized. Once the "hazard analysis" has been completed, steps are taken to co-ordinate actions to effectively deal with each emergency that could befall the community.

It is important to establish lines of authority in advance where several agencies will be involved with an emergency response. All responders must know in advance their respective roles and responsibilities. They must know who they report to and who reports to them. The plan must delineate reporting relationships, establish agreements for mutual aid, provide a list of available resources, identify notification and fan out system and outline how communication systems will function, including media relations. The plan must also identify specific training needs and include provisions for regular testing and evaluation with a systematic method for revisions and amendments. This process of emergency response planning also promotes awareness among members of the community, identifying potential dangers they could face and how they should behave should an emergency occur. This list is not complete but indicates how some of the difficulties faced during this

incident would have been avoided if a community response plan had been in place.

Recent hazardous material response training received by the local fire chief was certainly one of the most significant factors contributing to the successful outcome of this incident. Although some had training in this area many others involved in the response had very little or no training in this area at all. As well, several responders did not have adequate protective equipment and were limited in their ability to effectively support the emergency response.

As with most incidents communication was a problem. A cellular phone from the site assisted with initial notification, but radio communications were unavailable until Regina Fire Department arrived. They established a command post which was linked to the emergency co-ordination and media centre. Again, the lack of communication links presented some major problems with release of information to the media and coordination of resources at the scene.

It was also unclear as to who has the authority to order the evacuation of the town and under what conditions it should be carried out, if necessary. This authority must be clearly defined in the response plan.

In addition to the community response plan, it is imperative such facilities have a Fire Safety Response Plan. Although there are a number of plans and recommended practices available from different agencies, The National Fire Code 1990 outlines specific requirements for occupancies that involve hazardous materials. Further, CSA Emergency Planning for Industry, a National Standard of Canada provides solid guidelines for emergency response plans. This facility was not governed by applications of The National Fire Code of Canada, however, if it had been, an effective staff response plan would have been required.

Part of every emergency response must consider operations that continue beyond the initial emergency response. In this case, Environment Canada played a major role in assisting with the response immediately following the fire. Without their assistance, local response capabilities were limited. Their expertise, their detection and monitoring equipment, their mobile lab and their chemical entry suits placed them in a better position to respond to such an incident than any local agency. The participation and support from the Federal Government Department of Environment was invaluable to the post incident response and subsequent return of the situation to normal.

The response plan must address cleanup and restoration of the environment to its previous state. Again the lack of a formal response plan from the agency

using the facility led to some confusion and consequently poor initial control and assessment of cleanup operations at the scene. Containment of contamination is paramount and although security of the site was established quickly, little was done to control access to or from the contaminated area. With proper training, definite steps would been taken at the outset and control maintained until cleanup was completed.

## 2.2 RECOMMENDATIONS

**2.2.1** There are a number of codes, standards and recommended practices which could be adopted to ensure appropriate response plans are developed. The most significant improvement would be realized through adoption and enforcement of The National Fire Code of Canada on a province wide basis. This would ensure the safe operation of such facilities in all jurisdictions by providing community awareness and requiring fire safety plans to be in place. A copy of a Fire Safety Plan is attached in Appendix A.

It is recommended that the Province adopt 1990 edition of The National Fire Code of Canada.

**2.2.2** The Saskatchewan Emergency Planning Act (1989) states that every local authority shall "establish a local emergency measures organization" and further should establish a municipal emergency plan governing:

a) The provision of necessary services during an emergency;

b) The procedures under and the manner in which persons will respond to an emergency.

It is recommended that the community of Grand Coulee develop and implement their emergency response plan in accordance with Emergency Measures Organization guidelines and that it be tested on an annual basis. The Saskatchewan Emergency Measures Organization, through a public awareness campaign, can encourage and ensure all local authorities have community response plans in place.

2.2.3 This report identified the lack of equipment and suitably trained personnel to respond to such an incident. The police, the fire department and members of the Department of the Environment had limited direct experience with regard to hazardous material responses. It was further recognized that response personnel lacked appropriate protective equipment that would allow their full support in a safe manner.

It is recommended that training be made available to all emergency responders who could be called upon to deal with hazardous materials incidents. This training should meet as a minimum the requirements outlined in the National Fire Protection Association Standard 472, Professional Competence of

Responders to Hazardous Material Incidents.

Performance objectives are outlined for responders at the Awareness Level, the Operational Level, Hazardous Material Technician and Hazardous Material Specialist. All responders, including police, fire and ambulance should receive as a minimum, training at the Awareness Level. Training at the Awareness Level can take place locally with more advanced Hazardous Material Response training obtained through the Alberta Fire Training School.

It is recommended that a provincial emergency response team be established to deal with incidents of similar nature in the future. This would require initial and ongoing training for the response team, supported with equipment that would allow them to respond to a variety of incidents. It is recommended this training be provided in accordance with NFPA 471 Recommended Practice for Responding to Hazardous Materials Incidents. This standard outlines the minimum requirements for dealing with responses to hazardous materials incidents and provides specific operating guidelines in the following areas:

1. Administration
2. Incident Response Planning
3. Response Levels
4. Site Safety

5. Personal Protective Equipment
6. Incident Mitigation
7. Decontamination.

It is recommended that all levels of government: federal, provincial, and municipal, work together with industry and organizations such as MIACC (Major Industrial Accident Coordination Committee) to strengthen relationships and ensure the most effective response is provided when needed.

**2.2.4** Communication difficulties hampered both initial responders and additional support personnel. On site communications presented problems for the first responding fire department. If not for the arrival of a cellular phone, important initial notification of support agencies would have been delayed. The Regina Fire Department provided key communication links, including information releases to the media. Notification of government responders and their subsequent ability to communicate information from the site to other government officials was hampered. Also, it was not clear who the official spokesperson was to make comment on behalf of the government. In this case, because it was a government operation, a communication plan should have been in place by the Department operating the facility.

It is recommended that the community of Grand Coulee ensure their

emergency response plan includes a communication strategy that should ensure the notification of residents and the safety of all responders.

It is also recommended that the Government of Saskatchewan develop their own emergency response communication strategy to deliver and provide information when incidents similar to this one involve government departments. The control and planned release of accurate information is very important. This was very effective in the days following the incident however the day of the incident appeared inadequate.

The feasibility of a emergency 1-800 number or province wide 911 system should be investigated. This would allow for the notification of all agencies and personnel who have a response role or a vested interest in an incident of any nature.

## 3.0 ENVIRONMENTAL INVESTIGATION AND ASSESSMENT

### 3.1 Introduction and Objectives

The objective of the environmental investigation and assessment was to determine if any off-site contamination beyond the area adjacent to the former building had occurred and if so, to what extent. The environmental investigation focused on two primary areas:

1. Determining the existence and impact of any contamination at downwind residences as a result of dispersal of smoke from the fire; and

2. Determining the existence and impact of any contamination of soil, snow or water as a result of dispersal of smoke from the fire.

It must be recognized from the outset that the primary transport mechanism which could have resulted in off-site contamination would be smoke or soot generated during the fire. Typically, contaminants which are not consumed by the fire or which are generated as a result of the fire may be associated with soot carried aloft by the heat of the fire, eventually to settle to the surface of the ground, on residences or on water bodies. Subsequently, the environmental investigation focused on these components, primarily in downwind directions.

It must be noted that the results presented in this portion of the report are in some instances summaries of more extensive listings, with particular reference

to GC/MS (gas chromatograph/mass spectroscopy) results provided by Environment Canada, Emergency Sciences Division. Exhaustive listings of the results of GC/MS analysis as well as methodologies used in performing the analyses are provided in Appendix B. Additionally, the Microtox bioassay methodology and its significance to the results which follow are discussed in Appendices C and D.

### 3.2 Initial Preparations and Assessments

The following is a brief summary of the initial preparations for the assessment and environmental monitoring of the Grand Coulee transfer facility fire.

Saskatchewan Environment and Public Safety officials met with representative of Environment Canada on Thursday November 21, 1991, to review the event and determine what degree of assistance from Federal officials may be necessary. Saskatchewan Environment and Public Safety requested the assistance of Environment Canada officials in the morning of November 22, 1991 in: a) providing an "on-site" mobile laboratory and technician with the capability to do Microtox toxicity measures; and b) sending a team of experts from Ottawa to help the investigation team with advice on site entry, sampling program and clean-up measures. The mobile laboratory unit arrived at the site later in the afternoon. Officials from the Emergency Sciences Division of Environment Canada arrived late that evening at which time a meeting was

held to discuss strategy for a sampling program and an area entry program.

On November 22, 1991, the site was roped off by Saskatchewan Environment and Public Safety staff in the afternoon and was thereafter secured by a contracted security firm on a 24 hour basis. Prior to that time, the site had been secured by supervision of the Grand Coulee Fire Department or the RCMP.

Downwind residences were visited on morning of November 23 and both the morning and afternoon of the 24th by a team of Federal and Provincial officials. The objective of these visits was to obtain samples to determine if any contamination as a result of the fire had occurred. In the morning of November 23, 1991, a survey of a 2.5 Km. downwind area was also conducted by Provincial officials. The purpose of this survey was to establish sampling locations for the soil sampling which was to follow.

At noon on the 23rd, the preparation for the first entry and initial survey of the building was completed. Environment Canada specialists, Drs. Merv Fingas and J. Pare entered the burned area, with a provincial Fire Prevention officer, for the first time, after the fire, in totally-encapsulated suits. The survey revealed no toxic gases and innocuous radiation levels. This inspection also showed that the site was burned much heavier than expected and that there was only a small amount of ash remaining. Most drums of pesticides had

BLEVE'd (Boiling Liquid Expanding Vapour Explosion) and were empty. Only one full drum was found at the time. Very little of the structure was left. Several areas of the ground to the east of the building were lightly covered with pesticide spray resulting from the BLEVE's. No residues were found inside the building structure.

The analysis of the aggregate sample collected showed negative a result for cyanide. At about 3:00 p.m. Environment Canada specialists re-entered the contaminated site to collect ash samples at various spots around the perimeter and some soil samples from the discoloured area. Eight samples collected from this entry along with 17 wipe samples were eventually taken back to Ottawa for laboratory analysis.

On November 24, 1991, a storage shed less that 12 feet from the former structure was inspected by the Environment Canada entry team. It was necessary to enter this shed in order to determine its condition, since its proximity to the scene facilitated its use as future command centre for the clean up operation.

### 3.3 Assessment of Downwind Residences

The immediate primary concern of the environmental investigation focused on determining if any contamination of downwind residences had occurred as

a result of smoke or soot generated during the fire. As a result officials with Environment Canada with the assistance of Saskatchewan Environment and Public Safety visited farm homes on November 23 and 24, 1991, to obtain swab samples for determining if any contamination had resulted. Interviews with the residents were also obtained to confirm the path of the smoke plume. The results of 23 samples collected from farm residences are summarized in Table 3.1 while complete copies of analytical results appear as Appendix E.

**Table 3.1: Summary of Analytical Results of Samples Collected for Pesticides at Downwind Residences**

| Name and Location | Explanation of Analytical Results | Compounds Present and Level |
|---|---|---|
| Dale Hantelmann, kitchen floor wipe | no pesticide contamination | none |
| Dale Hantelmann, outside window facing north | no pesticide contamination | none |
| Michael Smith Farm, outside window facing north | no pesticide contamination | none |
| Marcus Hantelmann Farm, outside basement window, facing north toward site | very low pesticide contamination, reflect background levels of blow dust | hexachloro ethane, 2-ethyl hexanoic acid, 2-ethylhexyl diphenyl ester phosphoric acid, all in levels of ppb |
| Karl Reusch, outside window, facing north | no pesticide contamination | none |
| Ganshorn, kitchen floor wipe | no pesticide contamination | none |

**Table 3.1: Summary of Analytical Results of Samples Collected for Pesticides at Downwind Residences (continued)**

| Name and Location | Explanation of Analytical Results | Compounds Present and Level |
|---|---|---|
| A. Ganshorn, outside window facing north | no pesticide contamination | none |
| A. Ganshorn, outside window, facing west, toward site | no significant pesticide contamination, probably due to residual pesticides | pesticides levels in ppb |
| Marcus Hantelmann Farm, kitchen floor wipe | no pesticide contamination | none |
| Douglas Bates Farm, outside window, facing north, toward warehouse | no pesticide contamination | none |
| Douglas Bates Farm, kitchen floor | no pesticide contamination | none |
| Ron Perrault outside window,on porch facing west toward warehouse | no pesticide contamination | none |
| Ron Perrault outside window,on porch facing west toward warehouse (replicate) | no pesticide contamination | none |
| Mrs. Perrault (Sr.) outside window, facing west toward warehouse | no pesticide contamination | none |
| Mrs. Perrault (Sr.) inside, on hall-way floor | no pesticide contamination | none |

**Table 3.1: Summary of Analytical Results of Samples Collected for Pesticides at Downwind Residences (continued)**

| Name and Location | Explanation of Analytical Results | Compounds Present and Level |
|---|---|---|
| Don Loughren home, outside, west window | no pesticide contamination | none |
| Don Loughren home, inside, kitchen floor | no pesticide contamination | none |
| Bruce McCaskill Farm, outside north window (Mrs. McCaskill noted this area was heavy with smoke) | no pesticide contamination | none |
| G. Argue house, outside basement window, facing west, toward warehouse | no pesticide contamination | none |
| Stan Kostron house, inside, kitchen floor | no pesticide contamination none | |
| Stan Kostron house, outside window, facing north toward warehouse. | no pesticide contamination | none |
| field blank wipe 1, blank to test compounds present in wipe, solvent and bottle | wipes have bactericide in them at ppm level, this can be compensated for | none |
| field blank wipe 2, blank to test compounds present in wipe, solvent and bottle | wipes have bactericide in them at ppm level, this can be compensated for | none |

Note: The above noted samples were collected and analyzed by Environment Canada, Emergencies Science Division from the area surrounding the Grand Coulee transfer station. Samples were collected November 23, 24 and 25, 1991. Samples were analyzed by December 7, 1991. Analysis of samples from L. S. Ganshorn, L. Potter, J. Schubert and L. Shiplack residences was not performed since the results of other samples from homes closer to the site of the fire showed no significant contamination.

The results of Table 3.1 indicate that no toxins, be they pesticides, pesticide breakdown products or pesticide combustion products or any other chemicals attributable to the fire were present at the downwind residences following the fire of November 20, 1991.

### 3.4 Assessment of Off-site Soil, Snow and Water

Another area of concern for the environmental investigation focused on determining if any contamination of downwind soils, snow or waterbodies had occurred as a result of smoke or soot generated during the fire. As a result field sampling and investigations to determine the status of these resources were initiated as early as November 21, 1991.

On November 21, 1991, ten snow samples were taken in the area downwind of the former transfer site as an initial measure to ascertain the presence of organochlorine pesticides, phenoxy acid herbicides or cyanide. The results of these analysis are presented in Table 3.2.

**Table 3.2: Summary of Analytical Result of Snow Samples Collected from the Grand Coulee Area, November 21, 1991. (All Values Parts per Billion - ug/L)**

Grand Coulee Access Road

| Sample | Cyanide | Herbicides | Pesticides |
|---|---|---|---|
| A2 | <1 | <0.20 | <0.05 |
| A4 | <1 | <0.20 | <0.05 |
| A5 | <1 | <0.20 | <0.05 |
| A6 | <1 | <0.20 | <0.05 |
| A7 | <1 | <0.20 | <0.05 |
| C1(control)* | 2 | <1.0 | <1.0 |
| C2(control) | 21 | <0.20 | <0.05 |

Yards Immediately Downwind

| Sample | Cyanide | Herbicides | Pesticides |
|---|---|---|---|
| B1 | <1 | <0.20 | <0.05 |
| B2 | 2 | **20 | <0.05 |
| B3 | <1 | <0.20 | <0.05 |

*Walter Scott Building Grounds (Regina)
**Concentration was for 2,4-D. The rest of the herbicides are less than 0.20 ug/L.

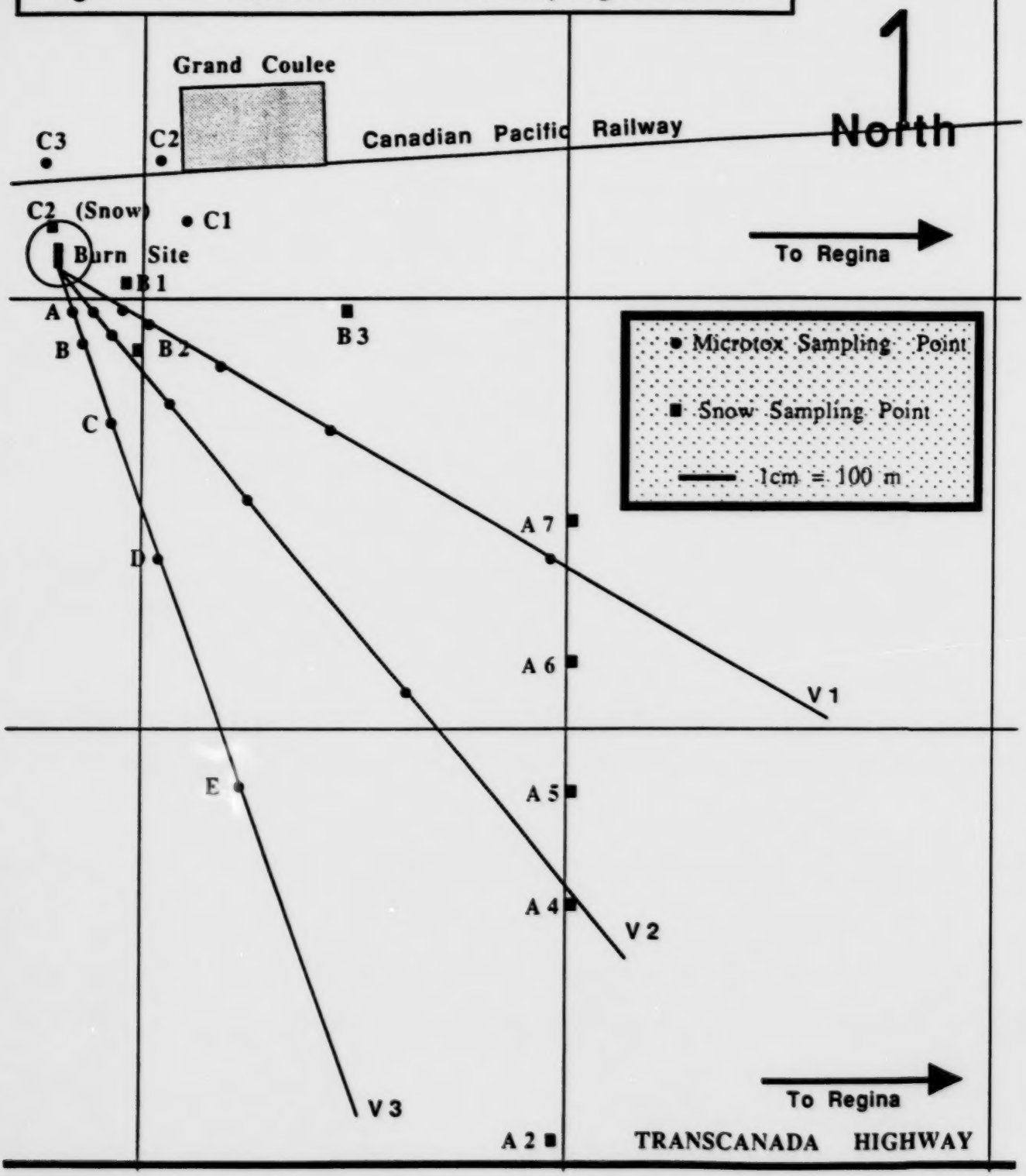
Note: Ten litres of snow were collected into plastic containers for analysis.values are µg/L (ppb).
Pesticide analysis included: Dicamba, 2,4-D, Silvex, 2,4,5-T, 2,4-DB, Picloram, Trifluralin, Triallate, Propanil, Bromoxynil, Diclofop-methyl, alpha-BHC, beta-BHC, Lindane, Heptachlor, Aldrin, Heptachlor epoxide, Dieldrin, Endrin, DDT (total isomers) and Chlorpyrifos.

The results of Table 3.2 indicate that herbicides were found in small concentrations (2,4-D at 20 ppb) at only one location within snow samples. All other instances show that no detectable phenoxy-acid herbicides or organochlorine insecticides were present. The potential presence of cyanide was of initial concern because of it was known to have been present in the warehouse, however its fate was not certain at the time. The result of the

sampling (Table 3.2) showed that the control samples collected in Regina, for reasons unknown showed higher concentrations of cyanide than did samples at the fire site. Additionally, two of the samples collected in downwind locations showed traces of cyanide, however it is believed that these values which were slightly above detection may have been the result of plant material collected with the snow samples. It was later learned that all cyanide materials present at the transfer station survived the fire.

Survey transects were established on November 23 in the direction of the smoke plume to the southeast of the site of the transfer station. Three downwind transects were established at 290, 300 and 310 degrees based on the dominant wind directions observed at the site during the fire. Samples were collected on the transects at the following distances: Ground zero; 100m; 500m; 1000m; and 2000m. Three control samples were taken upwind, two of which were collected between Grand Coulee and the fire site. Figure 3.1 depicts the location of the transects and soil sampling locations. All transects had both an upper (0-2 cm) and a lower (5-7 cm) sample collected. If no toxicity was found using the Microtox methodology in the upper sample, the lower sample was not analyzed. Results of the analysis of these samples are presented in Table 3.3.

## Figure 3.1 - Microtox and Snow Sampling Locations




Representational Diagram of Sampling Points
(approximate)

**Table 3.3: Summary of Results of Microtox Bioassay of Downwind Soil Samples, November 23 and 24, 1991.**

Background Samples

| Sample | Results | Sample | Results |
|---|---|---|---|
| C1 (0-2 cm) | Non-toxic | C1 (5-7 cm) | Non-toxic |
| C2 (0-2 cm) | Non-toxic | C2 (5-7 cm) | Non-toxic |
| C3 (0-2 cm) | Non-toxic | C3 (5-7 cm) | Non-toxic |

Downwind Soil Samples

| Vector 1 | | Vector 2 | | Vector 3 | |
|---|---|---|---|---|---|
| Sample | Results | Sample | Results | Sample | Results |
| A1 | Non-toxic | A2 | Non-toxic | A3 | Non-toxic |
| B1 | Non-toxic | B2 | Non-toxic | B3 | Non-toxic |
| C1 | Non-toxic | C2 | Non-toxic | C3 | Non-toxic |
| D1 | Non-toxic | D2 | Non-toxic | D3 | Non-toxic |
| E1 | Non-toxic | E2 | Non-toxic | E3 | Non-toxic |
| | | | | E3(1) | Non-toxic |

Note: Samples were collected using a standard hand corer to obtain a 15 cm deep core through the snow and soil. Collect the snow plus the 0 to 2 cm dirt in one sample. Discard the 2 to 5 cm stratum of core. Collect the 5 to 7 cm stratum in a second sample. Collect 10 replicate cores at each site and compound into one sample from each depth.

Microtox analysis of soil samples collected both at control locations and from the downwind transects (Table 3.3) all showed that no toxic components were present following the Grand Coulee fire.

Samples of snow and ice from downwind water supply reservoirs (dug-outs) to ascertain if any contamination had resulted from the fire. The results of the samples collected on November 25 and 26, 1991 are presented in Table 3.4. The results of these analysis indicate that no detectable toxic components were

present on the ice or snow of water supply reservoirs shortly after the Grand Coulee fire.

**Table 3.4: Summary of Results of Microtox Bioassay of Downwind Water Reservoir Snow and Ice Samples, November 25 and 26, 1991.**

| Sample # and Location | Land Location | Results |
|---|---|---|
| 1 - Lipsett, dugout ice* | NE20-17-21-W2 | Non-toxic |
| 2 - Sponsler, dugout ice | SW11-17-21-W2 | Non-toxic |
| 3 - Argue, dugout ice | NW2-17-21-W2 | Non-toxic |
| 3 - Argue, snow SE corner | NW2-17-21-W2 | Non-toxic |
| 4 - Hantelmann, dugout ice | NE34-16-21-W2 | Non-toxic |
| 5 - Hantelmann, ice | NE34-16-21-W2 | Non-toxic |
| 6 - Reusch, ice | NW35-16-21-W2 | Non-toxic |
| 7 - Smith, ice | SE2-17-21-W2 | Non-toxic |

* Denotes that this was an upwind control station.

## 3.5 Conclusion and Recommendations

The value of maintaining a response capabilities able to deal with events of this nature is evident from the Grand Coulee example. Initial assessment of the former structure by the Environment Canada, Emergency Sciences Division revealed that no toxic gases persisted and that radiation levels were innocuous. The site was burned much heavier than expected and that only a small amount of ash was remaining. These surveys were very useful in assessing the status of the former facility following the fire and offered guidance regarding personal protective equipment necessary for both fire investigators and the clean-up workers. It therefore recommended that provincial capabilities in terms of

personnel, training and equipment be provided to deal with incidents of this nature in the future.

The results of the investigation provide the general conclusion that significant off-site contamination of surrounding residences and areas was not evident from samples collected within four days of the fire. The following specific conclusions are also drawn from the investigation and the results that it generated:

1. The analytical results of samples indicate that no toxins, be they pesticides, pesticide breakdown products or pesticide combustion products or any other chemicals attributable to the fire were present at the downwind residences following the fire of November 20, 1991;
2. The results of the investigation indicate that herbicides were found in small concentrations (2,4-D at 20 ppb) at only one location within snow samples. All other instances show that no detectable phenoxy-acid herbicides or organochlorine insecticides were present within snow downwind from the fire site. The potential presence of cyanide was of initial concern because of it was known to have been present in the warehouse, however its fate was not certain at the time. The result of samples collected during the investigation showed that cyanide was generally not detected in snow downwind from the site. Although two of

the samples collected in downwind locations showed traces of cyanide slightly above the level of detection, it was postulated that the values may have been the result of plant material collected with the snow samples. This conclusion is reinforced somewhat by the fact that it was later learned that all cyanide materials present at the transfer station survived the fire;

3. Bioassay analysis of soil samples collected both at control locations and from the downwind transects all showed that no toxic components were present within the soils following the Grand Coulee fire; and
4. The results of the investigation and sample bioassay analysis indicate that no detectable toxic components were present on the ice or snow of downwind water supply reservoirs shortly after the Grand Coulee fire.

## 4.0 FIRE INVESTIGATION

The following information is presented as a summary of findings outlined in the detailed Fire Investigation Report. Facts presented are intended to outline particular problems and provide recommendations based on the conclusions. The complete fire report is on file with the Fire Commissioner's Office.

At approximately 1715 hours on Wednesday, November 20, 1991 a fire of undetermined cause occurred at a farm located 1/4 mile southwest of the town of Grand Coulee. The fire resulted in total destruction of a building used by the Government of Saskatchewan for its Agricultural Chemical Collection Program.

There were no deaths or injuries associated with this fire. The property damage is estimated at $200,000 with a final dollar loss yet to be determined.

### 4.1 The Structure

The building was originally constructed in 1964 as a turkey shelter with some modifications carried out in the early seventies. This was a single storey structure, fifty feet wide by two hundred and forty feet long. The exterior walls and roof consisted of galvanized, corrugated steel erected over a steel reinforced concrete floor. The building was divided by a wooden stud, plywood covered

wall separating the north and south ends. Access to each area was through a large, rolling door centred in the wall. The north portion of the building was one hundred feet by fifty feet. The interior walls in this section were lined with 2" x 6" wooden studs. The walls and ceiling were insulated and covered with 3/8" plywood. The south portion of the building was one hundred forty feet by fifty feet and was further divided providing a separate section from the rest of the building. This was originally done to allow the required one hour fire separation for the safe storage of flammable liquids. This portion of the building was not part of the current lease and was used by the owner for storage. It was constructed of 2" x 4" wooden studs with 5/8" gypsum board on both sides. The only access to this area was from the outside. The southern portion of the building had originally been insulated with a spray on polyurethane foam applied directly to the metal walls and ceiling. This foam was later covered with 1/2" gypsum board on the ceiling and with a spray on mineral fibre insulation on the walls.

This structure was heated by eight natural gas furnaces, spaced throughout the building and had full electrical service.

## 4.2 Background

The building was leased by the Government of Saskatchewan in 1976 for the storage of farm chemicals by the Saskatchewan Department of Agriculture. The

original lease was for 10 years and was renewed on a yearly basis after 1986.

Upon a request from the Department of Occupational Health and Safety the building had been inspected in 1977 by the Fire Commissioner's Office. A major concern identified at this time was the exposed polyurethane foam insulation, which had been applied directly to the interior steel ceiling and walls, presented a serious fire hazard. This foam was subsequently covered with a spray on mineral fibre insulation to provide a required 10-15 minute thermal barrier. A layer of 5/8" gypsum board was also installed over the foam on the ceiling. The building was reinspected a year later where it was noted that the mineral fibre, protective covering was falling off, leaving the polyurethane foam exposed. There is no information to indicate a protective covering was ever reapplied. Photographs taken of the building interior in 1990, show the mineral fibre covering had fallen away in a number of places. This was particularly noticeable in the area of the furnace located at the northeast corner of the south section.

From 1986 to 1988, building occupancy was shared with the Departments of Agriculture and Environment and Public Safety. In 1989, Environment and Public Safety began operating the facility to support the "Agricultural Chemical Collection Program". The last lease expired in May of 1991 and was renewed on a monthly basis in anticipation of moving the operation to an alternative

location.

Saskatchewan Property Management Corporation (SPMC) had negotiated the leases and served as broker between owner and tenant. SPMC sent a letter, dated June 4, 1990, to the building owner, listing a number of deficiencies. One of the deficiencies referenced electrical problems with the lights and exhaust fans on the east wall. There is no information to indicate this problem had ever been repaired.

On November 4, 1991 an electrician, hired by the owner, replaced three electrical breakers, lit three furnaces and relocated two thermostats.
On the day of the fire, three employees from Department Environment and Public Safety were working in the building from 0845 to 1335 hours. Their activities consisted of removing the tops of five gallon containers, extracting any chemical residue and rinsing out the containers. The solid residue and rinsings were placed in separate 45 gallon drums and sealed. It was noted in statements taken by the fire inspectors that a make shift trouble light was used to improve lighting in the area where these people were working. When they left the building at 1335 hours they claimed to have shut off all the electrical fans and lights. This was done by switching off the breakers at the electrical power panel.

It should be noted that the Agricultural Chemical Collection Program was not an ongoing process requiring full time attendance and involvement of workers at this site. Activities at the depot were dictated by the volume of chemical containers collected and shipment arrivals and departures on a weekly basis.

The owner is believed to be the last one in the building prior to the fire. At approximately 1600 hours he entered the building to see why a wall fan shutter on the east side of the building was open. He walked through the building, at the same time checking to see the quantity of chemicals left to be shipped out. He did not turn any breakers on yet his statement mentions a portable trouble light was left on and he unplugged it and left the building. Sometime later, between 1615 and 1645 hours he placed some tools in the small garage adjacent to this facility and went for supper. He noted nothing out of the ordinary at this time.

### 4.3 The Fire

At 1715 hours a member of the Grand Coulee Fire Department observed grey-black smoke coming from the east side of this building and alerted the fire department. The Fire Chief contacted the building owner by phone and advised him of the situation. Going outside, the owner saw grey black smoke coming from the building. As he approached he could hear sirens from the local fire department. His first action was to shut off all the electrical breakers

in the power panel. While doing this, he noticed one of the breakers was in the tripped position. Investigators later determined it was an electric fan breaker that had tripped. The owner then proceeded to shut off the natural gas supply to this building.

One of the first actions taken by the fire department was to open the large doors at the north end of the building. This was in an attempt to locate the seat of the fire. They could see nothing due to heavy black smoke. One of the firefighters checked the building exterior, feeling the walls and doors for hot spots trying to establish location of the fire. He discovered a hot spot on the east side of the building just north of where the natural gas service enters the building. See Diagram Appendix F. This was in the northwest corner of the south section where one of the natural gas furnaces was located. This was also the section where exposed polyurethane insulation had been identified by photos taken in 1990.

## 4.4 Damage

Due to the nature of the building contents a decision was made by the fire department not to extinguish the fire. The fire led to the total destruction of the building and its contents. The chemicals exposed to the fire were virtually incinerated. This decision led to the prevention of death and injuries and minimum environmental contamination making cleanup of the site relatively

easy. The fire was reduced to a smouldering state by 2200 hours and had burned itself out by midnight.

## 4.5 Cause and Origin

Investigation into the cause and origin of this fire began immediately. The fire investigation team, consisting of a local fire department representative, a member of the RCMP General Investigations Services and two inspectors from the Fire Commissioner's Office, was established. This team concept is consistent with most fire investigations undertaken by the Saskatchewan Fire Commissioner's Office.

Immediate access to the building was restricted due to the remaining heat and unknown properties of the chemical residues. However, photographs were taken, site drawings were prepared and interviews with witnesses began.

Fire investigators first gained access to the building on Saturday, November 23, 1991. It was apparent that most equipment, the building and materials exposed to the fire had been heavily damaged.

In order to investigate the fire it was necessary to recreate the scene prior to the incident taking place. To do this required the review of building drawings as well as interviews with all people who were involved in activities that took

place in the time preceding, during and immediately after the fire. This is especially important when the fire causes such extensive damage and destroys many of the indicators necessary for determining the cause.

All known possible causes of ignition had to be identified and eliminated one by one. In this case the pilot light on the natural gas furnace and electricity were identified as two possible ignition sources. The Gas and Electrical inspectors were on the site Tuesday, November 26, 1991 to determine if these items may have caused or contributed to the spread of the fire.

The Electrical Inspection Branch of SaskPower was asked to examine the electrical distribution system and any remaining electrical appliances to determine if these could have caused the fire. All items checked were too badly burned to furnish any substantial information.

Inspectors from SaskEnergy also examined the furnaces and natural gas piping throughout the building. They found no evidence to indicate one of the natural gas furnaces had caused the fire nor was there evidence to support a natural gas leak had occurred. Copies of their findings are included with the detailed fire investigation report.

The possibility of a heat producing chemical reaction created by mixing

incompatible or reactive chemicals was considered. Discussing this with the building operators suggested it was possible but extremely remote. Damage was too extensive to clearly determine if this had or had not occurred.

There were a number of explosions witnessed during the fire. The majority of these occurred as drums which contained combustible liquids, became heated and exploded. These explosions are more appropriately described as Boiling Liquid Expanding Vapour Explosions or BLEVES. One particular explosion worth noting was that of a white fireball coming from the northeast corner of the building. This was determined to be caused by the eruption of several ethylene dibromide and ethylene oxide cartridges stored in this area.

Observations by the inspectors noted extensive spalling and damage to the concrete floor throughout the building. This spalling had no particular pattern and could have been caused by the explosion of drums spilling combustible liquids on the floor.

The fire investigation team attempted to establish the fire's point of origin. Statements from witnesses, indicating parts of the structure which were hot to the touch, the point where fire first burned through the roof and areas of most intense heat, help to locate the point of origin. It should be noted these indicators are not always conclusive as methods of construction and fuel loads

within a structure will affect the growth and spread of fire. The fire investigation team believed the point of origin to be somewhere about midway along the east side of the building. This was in the vicinity of the furnace located in the northeast corner of the south section. This was also near the location where the natural gas service entered the building and where the hot spot on the wall had been identified by the fire fighter.

The fact the building was filled with thick, heavy smoke very early in the fire, led inspectors to believe the possible ignition of flammable or combustible liquids had occurred. When burning, these types of materials generate large quantities of heavy grey-black smoke. The ignition of polyurethane foam insulation on the wall of the northeast corner of the south section would also produce heavy black smoke. Review of Saskatchewan Environment and Public Safety's computer sketch of the storage of materials in the building, as well as examining the remains of evidence at this location, showed no chemicals were stored in this area. In fact all chemicals and drums were stored some distance from this location. Questioning Saskatchewan Environment and Public Safety staff, revealed no one had been in that area on the day of the fire. The furnace located in this area had already been eliminated as cause of this fire. It is possible that rapid development and dense concentrations of smoke was caused by ignition of the polyurethane foam in this area.

The cause of ignition and in particular the ignition of the polyurethane foam insulation may have been electrical. Examination of the electrical breaker box revealed a breaker was in the tripped position. Tracing this wire back from the breaker panel, led to the north section of the building, passing through the area deemed to be the point of origin. This wire was installed in the ceiling joists above the 5/8" gypsum board which would protect it from a fire occurring below the ceiling. It is possible that the burning polyurethane foam would quickly ignite the plywood covered wall that divided the north and south sections. This could have attacked the wire in the early stages of fire tripping the breaker. It is also possible that a fire could have occurred on the north side of the dividing wall causing the wire to short out and trip the breaker.

Three sets of wires from the electrical panel had been strapped to a board approximately four feet above the grade beam along the east wall in the south section. These wires would have to run behind the furnace located in the northeast corner of the south section. It is believed these wires supplied power to the furnaces, as well as to the wall outlets. It is quite likely this furnace was supplied with power from one of these sets of wires. If this was the case, there would have been a junction box somewhere in the area behind or around the furnace. Fire damage in the area of the furnace was too extensive to properly determine the type of electrical connection used.

It should be noted that the installation of the wires in the wall behind the furnace, the east wall, and the wires in the joist space of the ceiling in the south section were installed before the installation of the spray-on polyurethane foam. Research by the investigators identified the possibility of fire originating inside a wall and/or wall cavity where polyurethane foam insulation exists. Overheating of electrical wires due to the thermal insulation surrounding the wire, may trap heat build up in the wires. Further research led to the review of a report on polyurethane foam insulation from the Upjohn Chemical Company called "Fire Risks and Safety". In the report, they advise that:

> **"electrical wiring applications require specific attention, for buildings insulated with spray foam. Electrical work should be undertaken with either raceway systems or shielded cable such as BX."**

Such was not the case regarding the electrical installations in this building. The report also went on to say:

> **"Fires involving polyurethane foams produce large quantities of dense smoke which can be generated very quickly. The smoke may be so intense that it may obscure exits, cause panic, or irrational acts by persons in the fire zone, preventing escape from the danger area."**

This description fits with observations made in the early stages of this fire. This report also states:

**"that where rigid polyurethane foam completely encapsulates electrical wires, as in a spray foam operation, heat developed from an overload of the wire could, if sustained, present a potential fire risk."**

They also advise that special care is required around junction boxes, and light fixtures. It was evident this was not done when the foam insulation was applied to this building.

## 4.6 Fire Growth and Spread

A fire in the north-east corner of the south section, involving the polyurethane foam insulation would quickly build up heat and dense heavy black smoke. The burning insulation would also cause smoke to come out the eaves, as observed by persons first on the scene. The build up of heat and smoke in the south section would then vent smoke and hot gases as well as flames through the door opening into the north section. The area first ignited in the north section, would be the ceiling immediately north of the entrance between the north and south sections. This is the area where the fire was first observed venting through the roof. By viewing the video footage from news reports, investigators determined the fire progressed south along the roof and then northward from this area.

Prior to the fire burning through the roof, numerous explosions within the

building were recorded. These would have been the explosions of 45 gallon metal drums containing combustible/flammable liquids.

The spread of fire from the point of origin was accelerated by the combustible wall finish of plywood and exposed polyurethane foam insulation. This, in conjunction with the combustible contents of the building, allowed the fire to reach major proportions very quickly.

## 4.7 Findings

1. That a fire occurred on November 20, 1991, at 17:15 hours in a waste chemical transfer facility leased by Saskatchewan Environment and Public Safety. The property is 1/4 mile south-west of Grand Coulee.
2. That the building was allowed to burn, with no fire fighting efforts, resulting in destruction of the building and its contents.
3. That the arriving firefighters had made the correct decision to allow the fire to burn, due to the nature of building contents.
4. That the insurance on the building was $189,000 and was carried by the owner of the building.
5. That there was a 10 month lease on the premises and it was Saskatchewan Property Management Corporation's intention to terminate the lease in May of 1992 and relocate the facility.
6. That there was no loss of life or injury as a result of this fire. This is due

largely to the actions taken by the responding agencies.

7. That there was no security for the building, and it was not fenced. There was no automatic sprinkler system or fire alarm system. There is no indication that a fire safety plan was in effect.
8. That the owner and numerous other people who knew where the key to the building was located, had easy access to the building. Also, one of the three latches on the north door was broken and was not locked.
9. That the building did not meet National Fire Code of Canada Standards for this type of occupancy.
10. That at least one area of fire origin has definitely been determined, this area is the north-east corner of the south section.
11. That the building was heated with 8 natural gas forced air furnaces.
12. That proper fire separation was not provided for types of dangerous goods stored in the building.
13. That there was no indication that the building was properly placarded as required by the 1990 National Fire Code.
14. That no indication of proper direct emergency response training was provided for staff.
15. That the concrete spalling of the floor in this building, does not follow any general pattern, such as a pour pattern where a person intentionally setting a fire may pour a flammable or combustible liquid on the floor.
16. That the spalling of the concrete floor in the north section is quite spotted

and occurs in a number of areas across the floor. This spalling may have been caused by chemicals erupting out of drums and then burning on the floor.

17. That the landlord's property had a 1 hour fire separation between it and the rest of the building.

## 4.8 Conclusions

It is possible this was an accidental fire with the point of origin being near the wall in the north east corner of the south section. Research by the investigators, heavy black smoke observed coming from the eaves and the firefighter locating a hot spot on the wall, supports the possible ignition of exposed polyurethane foam insulation in this area. The ignition may have been caused by overheated electrical wires.

**However, due to the lack of factual information the cause of this fire is listed as undetermined.**

## 4.9 Code Analysis

This facility was not governed by the requirements of The National Fire Code of Canada. However, the following list identifies several deficiencies that could have been eliminated if in fact this facility had been governed by the Code. Property loss and risk to people and the environment would have been greatly

reduced.

1. Heating System

   The building was heated with 8 natural gas furnaces located throughout the building.

   Sentence 3.3.6.2.(1) of The National Fire Code forbids the use of fuel burning appliances in fire compartments used for storage of flammable or oxidizing dangerous goods.

2. Fire Safety

   There is no indication that a fire safety plan was in effect.

   Article 3.3.2.6. and article 5.1.6.1. of The National Fire Code requires a fire safety plan for this type of occupancy.

3. Separation from other Dangerous Goods

   Proper fire separation was not provided for the types of dangerous goods stored in the building.

   Article 3.3.6.6. of the code requires that certain types of dangerous goods be separated and even prohibit the storage of certain chemicals in the same

compartment, ie., flammable liquid cannot be stored in same fire compartment as poison gas, corrosive gas or oxidizers (Table 3.3.6.B).

4. Fire Suppression System

There was no automatic sprinkler system installed in the building - there was no water supply provided to fight a fire.

Article 3.3.6.9. requires this type of occupancy be sprinklered.

5. Placarding

There is no indication that the building was properly placarded in accordance with the 1990 National Fire Code.

Article 3.3.6.14. requires that placards be posted to conform with the requirements of Transporting Dangerous Goods Regulations.

6. Training

There is no indication that proper direct incident response training was provided and maintained for the staff.

Article 3.3.6.15. states that proper training be provided as per the requirement of Transporting Dangerous Goods Regulations.

7. Part 5 of The National Fire Code identifies Hazardous Materials Processes and Operations. This section specifies the fire safety precautions for storage of all categories of dangerous goods.

**4.10 Recommendations**

1. The National Fire Code is a companion document and essential for the administration and enforcement of the following codes and regulations:

   A) National Building Code

   B) Hazardous Substances Regulations

   C) Transportation of Dangerous Goods Regulations.

   The National Fire Code of Canada in conjunction with these codes will help ensure facilities are suitably constructed, protected and operated in the best interest of those who work there, the communities they are located in as well as ensure a qualified emergency response is available if necessary.

   It is recommended **The 1990 National Fire Code of Canada** be adopted in its entirety and any further additions with amendments. The adoption of **National Fire Code of Canada** will reduce the possibility of similar occurrences in the future. It will help minimize risk to employees, keep

communities safe and protect the environment from pollution and contamination.

2. The local authority having jurisdiction, must ensure these facilities are inspected regularly and all codes are enforced. All locations, where dangerous goods are stored, must be identified and response plans provided to the local fire department. This will provide the "**Right to Know**" for members of the community as well as support preparation of the overall community response plan. It is recommended that an inventory of all hazardous material sites be established and that regular inspection cycles be maintained. Response plans must be provided to the local fire department in accordance with The National Fire Code. It should be the role of the Provincial Fire Commissioner's Office to audit inspections of these facilities.

3. The National Fire Code addresses the importance of environmental issues and safety standards underlying the use of special facilities for both the storage and transfer of new and used chemicals and hazardous substances including wastes and flammable materials. It is recommended that location of such sites be established in accordance with set criteria with consideration for risk to people, property and the environment. This would be done in consultation with the Department of Environment and

Public Safety. As well the Crop Protection Institute of Canada Warehousing Standards provides recommendations for siting such facilities which can be used as a guide. These facilities must also be constructed and maintained in accordance with The National Building Code of Canada. Plans for new facilities and alterations to existing facilities should be approved by the authority having jurisdiction submitted to the Fire Commissioner for review.

4. Restricted access to and from hazardous material sites and security of products stored there is critical to the safe operation of such facilities. It is recommended that physical security, including locks, fences and access and inventory control be maintained at all hazardous material storage locations.

5. The Crop Protection Institute of Canada has developed "Warehousing Standards" for the storage of crop protection products for agricultural use and storage of pesticides for industrial use. It is recommended that all facilities be constructed, managed and operated in accordance with these standards or equivalent provincial standards.

## 5.0 CLEANUP AND MONITORING

Following the completion of the initial assessment of the fire scene situation and sampling for downwind impacts by Provincial and Federal officials on Sunday November 24, 1991, a preliminary site assessment report and a suggested cleanup was provided by Dr. Merv Fingas of Environment Canada. This information is provided within Appendix G since it formed, in part, the basis for the cleanup and monitoring activities which ensued. Please refer to the Priority Cleanup Suggested section within Appendix G for further information with respect to the suggested cleanup actions. Additionally, exhaustive listings of the results of GC/MS analysis as well as methodologies used in performing the analyses are provided in Appendix B. The Microtox bioassay methodology and its significance to the results which follow are discussed in Appendices C and D.

In order to describe the cleanup and monitoring activities in the most concise manner possible, the information which follows focuses on the location of concern.

### 5.1 Initial Preparations and Assessments

The following is a brief summary of the initial preparations and assessment conducted at the early stages of the clean-up of the Grand Coulee transfer facility structure and immediate surrounding area.

With respect to a control point to limit the possible spread of contamination by footwear during clean-up, an initial system was established on Tuesday November 26 by the fire officials. A 26 X 10 Ft. Highways Department construction trailer arrived on November 27 to function as a formal site office and control point. Furnishings and wash-up facilities were provided by SPMC. Provincial Occupational Health and Safety representative were consulted with respect to both chemical related and demolition related safety concerns and requirements and all materials and supplies were on-hand for the commencement of the clean-up activities.

On November 21, 1991, the day following the fire, samples of ash were collected from the scene to provide vital initial information regarding the degree of herbicide, pesticide and cyanide contamination of the remnants of the fire. The results of the analysis of these samples is presented in Table 5.1.

**Table 5.1: Summary of Analytical Results of Initial Ash Samples from the Grand Coulee Fire Scene (All Values Parts per Billion - ppb).**

| Ash Samples Sample | Cyanide | Herbicides | Pesticides |
|---|---|---|---|
| Warehouse | <0.1 | <0.05 | <0.05 |
| Warehouse | <0.7 | <0.05 | <0.05 |

Note: The warehouse ash samples were replicates collected from just within southeast corner of the former structure. Pesticide analysis included: Dicamba, 2,4-D, Silvex, 2,4,5-T, 2,4-DB, Picloram, Trifluralin, Triallate, Propanil, Bromoxynil, Diclofop-methyl, alpha-BHC, beta-BHC, Lindane, Heptachlor, Aldrin, Heptachlor epoxide, Dieldrin, Endrin, DDT (total isomers) and Chlorpyrifos.

The results of the initial ash samples indicate that contamination of the structure and immediate area was not as high may have been possible considering the magnitude of the fire. In fact the samples (Table 1) all showed that the parameters of concern were in fact below the detection levels.

Two initial samples of the snow and ice were collected on November 23, 1991, from approximately 50 meters southeast of the former structure, from a area of frozen ponded water on the landlords property. These samples were collected to determine the degree of contamination within the area which was suspected of being splashed from BLEVE'd containers. The results of the Microtox assay of these samples is presented in Table 5.2.

**Table 5.2: Summary of Microtox Assay of Snow and Ice Sample from Sprayed Area, November 23, 1991.**

| Sample | Results |
|---|---|
| Splash 1 (coloured) | Very Toxic |
| Splash 2 (clear) | Toxic |

Note: The first sample, labelled Splash 1, was coloured with visible stains of what was believed to be pesticides. The second sample, labelled Splash 2, was taken directly beside the first sample but did not show any visible stains.

The results of these samples (Table 5.2) indicated that the apparently both visibly contaminated and non-contaminated portions of the area in question were toxic as detected by the Microtox methodology. It was later learned that

this area is actually the outflow of the sewage tile field for the farm residence.

Initial Samples were taken from within the shed adjacent to the former structure on November 23, 1991, to determine the degree of contamination within the building. Swabs of hand tools and the desk within the building as well as a blanks sample were both collected. The results of Microtox assay of these samples is presented in Table 5.3.

**Table 5.3: Summary of Swab Sample Microtox Assays for Samples from Within the Shed Adjacent to the Former Structure, November 23, 1991.**

| Sample | Results | Light Reduction |
|---|---|---|
| Blank wipe | Toxic | (26/76) |
| Office mt-2 | Toxic | (10/82) |
| Tools mt-1 | Toxic | (2/82) |

The results for the blank sample within Table 5.3 indicate that Kim-Wipe tissues employed for performing swab sampling of surfaces actually gave a reduction in light (measure of toxicity) due to a toxic component of the material itself. As a result of the toxicity of the wipe blank, the results for the other two samples from within the shed are questionable. What these samples did indicate was that a different sampling medium for performing assay swabs was necessary. Resolution of the initial difficulties associated the swab medium are reported in later in conjunction with Table 5.23.

## 5.2 Soil

Removal of the larger areas of soil from the contaminated area to the east of the former building and to the north of the east-west access road was initially attempted using a highways department power sweeper. The use of the power sweeper was envisioned since it was hoped that it would be most efficient in removing just the desired upper layer 3-5 cm layer. Initially it appeared that the power sweeper would function satisfactorily however, the technique failed because of ground conditions and accumulation of excessive amounts of soil which the sweeper could not handle satisfactorily.

Soil from the majority of the area surrounding the building on the east and north sides was ultimately removed in late November by a bobcat and placed within 4-30 cubic yard luggers and one small pile to await sampling, analysis and disposal. Soil from the areas immediately adjacent to the former structure within 10 meters of the east side and 2 metres of the north side could not be removed because of the proximity to the building structural debris and the ongoing fire investigation. Approximately 100 cubic yards of soil was removed by this process and temporarily stored.

Composite samples were collected from the luggers and one storage pile and were analyzed by both Microtox assay methodology and for chemical parameters of concern dictated by the initial findings of Dr. Fingas' investigation by Gas-

Liquid Chromatography. Table 5.4 provides the results of the Microtox bioassays. Table 5.5 summarizes the results of chemical analysis.

Microtox bioassays of composite samples (Table 5.4) showed that soils within luggers 1, 2 and 3 was non-toxic. Results of discrete chemical analysis (Table 5.5) confirms and expands the indications of the Microtox methodology. Actual values range from less than the detectable level of 0.1 parts per million (ppm) dry weight for Trifluralin to a maximum of 320 ppm for Heptachlor for soil within lugger 4. Noticeably, 2,4-D was present in all samples including a control obtained from 200 metres to the west of the site. The occurrence of 2,4-D in the control sample indicates a small carry over of chemical applied in the past for agricultural purposes. The results also confirm that the initial area prescribed within Dr. Fingas' recommended soil removal area may have been somewhat too large particularly to the north of the former structure. The results also lend evidence that NW to NNW winds during the fire event, were the primarily governing factor which directed dispersal of sprayed chemicals lofted into the air due to BLEVE'd containers.

**Table 5.4: Summary of Analytical Results for Microtox Bioassay of Soil Samples, December 12, 1991**

| Sample | Results |
|---|---|
| L1 | Non-toxic |
| L2 | Non-toxic |
| L3 | Non-toxic |
| L4 | Toxic |
| L5 | Toxic |

Note: Collection employed a standard hand core sampler to obtain a 15cm soil core. Nine replicates were collected and composited. Samples analyzed by Environment Canada mobile laboratory.

**Table 5.5: Summary of Results for GLC Analysis of Soil Samples, December 18, 1991, (all values Parts per Million).**

| GLC Analytes | L1 | L2 | L3 | L4 | L5 | L6(control) |
|---|---|---|---|---|---|---|
| Heptachlor | 0.4 | 5 | 75 | 320 | 270 | <0.1 |
| Triallate | <0.1 | 2 | <0.1 | <0.1 | <0.1 | <0.1 |
| Trifluralin | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| DDT | <0.1 | 5 | <0.1 | 2 | 21 | <0.1 |
| 2,4-D | 0.65 | 0.36 | 0.16 | 0.62 | 180 | 0.05 |

Note: Collection employed a standard hand core sampler to obtain a 15cm soil core. Nine replicates were collected and composited. Soil samples from above analyzed by Saskatchewan Research Council.

Information regarding the level of contamination of the collected soils was employed to decide on how these materials were to be handled or otherwise disposed of. Since the concentrations of contaminants within the soils of luggers 1 and 2 was within the range of values generated by agricultural practice, these materials were spread to the north of the former structure. Soils within luggers 3 and 4 as well as the small pile were consigned to a chemical waste management company and transported to a secure landfill. These materials were shipped by means of bulk waste transport according to the requirements of the Transportation of Dangerous Goods Regulations on February 25 and March 12, 1992.

The upper contaminated layer of soil from the east-west access road by hand broom on Tuesday November 26, 1992. Samples collected and tested using the Microtox system (Table 5.6) shows that sweeping to remove surfacial pesticide spray was indeed an effective technique. Materials generated through this process were included with shipments of contaminated soils.

**Table 5.6: Summary of Microtox Bioassay Results of Soil Samples from East-West Access Road Following Removal of Contaminated Material, November 26, 1991.**

| Sample | Results |
|---|---|
| West of Perrault workshop | Non-toxic |
| East of Perrault workshop | Non-toxic |

Note: Soil samples from the east-west access road after sweeping method was applied. Using a spatula, a 5 gram surface sample was collected from road. Ten replicates were collected and composited to form each sample.

Following the completion of both the removal of contaminated soil and demolition of the structure, soil samples were collected from the area surrounding the former structure to assess the degree of removal of contaminants. The results of the Microtox bioassay of these samples is presented in Table 5.7.

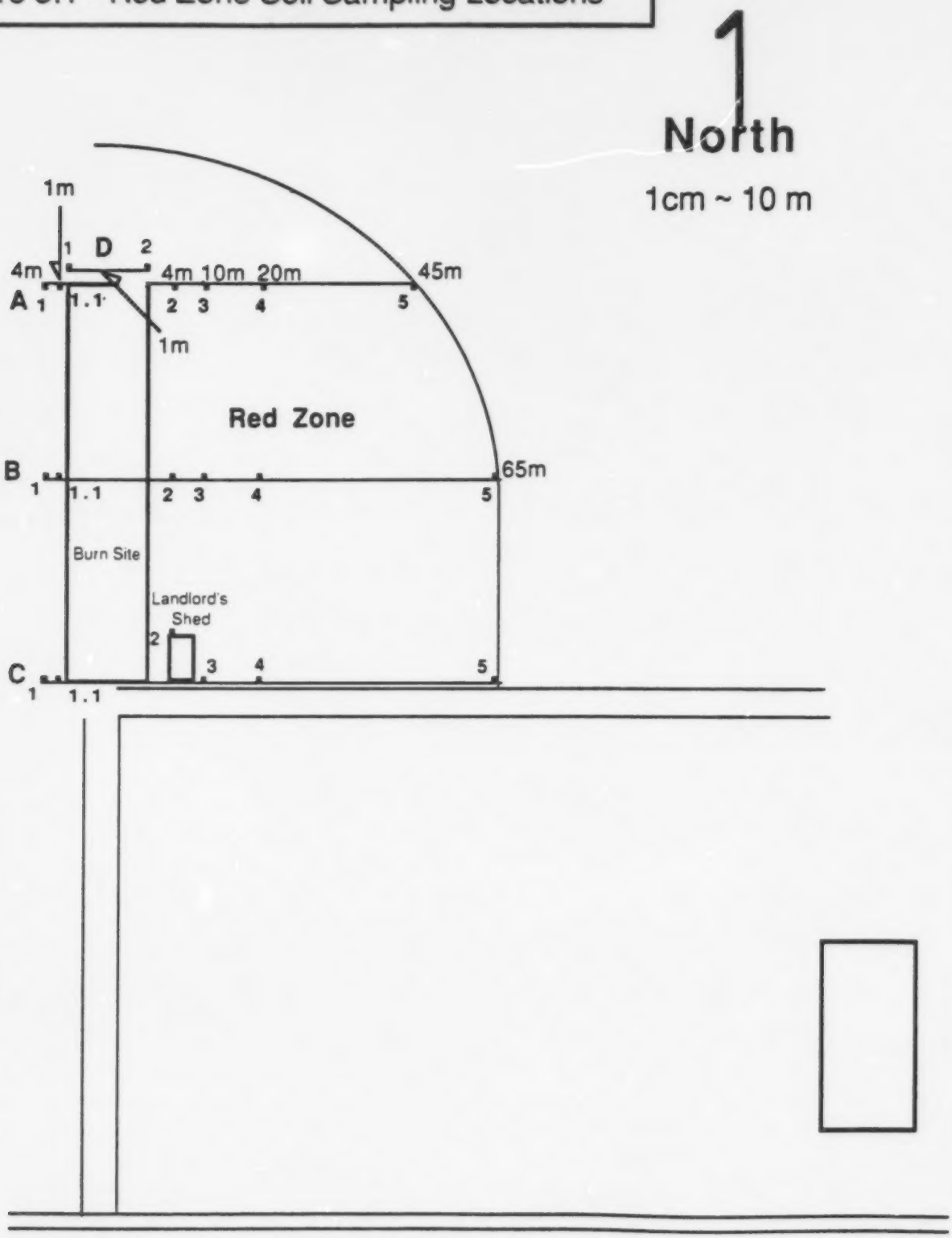
**Table 5.7: Summary of Soil Bioassay Results Following Removal of Contaminated Upper Layer, November 29, 1991 and December 6, 1991**

| Sample | Result | Sample | Result | Sample | Result |
|---|---|---|---|---|---|
| A1 | Non-toxic | B1 | Non-toxic | C1 | Non-toxic |
| A1.1 | Non-toxic | B1.1 | Non-toxic | C1.1 | Toxic |
| A2 | Non-toxic | B2 | Toxic | C2 | Non-toxic |
| A3 | Non-toxic | B3 | Toxic | C3 | Non-toxic |
| A4 | Non-toxic | B4 | Non-toxic | C4 | Non-toxic |
| A5 | Non-toxic | B5 | Non-toxic | C5 | Non-toxic |
| D1 | Non-toxic | D2 | Very Toxic | | |

Note: Soil samples collected from area adjacent to the former structure after removal of contaminated soil with blade (see Figure 5.1). Using a spatula, a 5 gram surface sample was collected from location indicted in Figure 5.1. Ten replicates were collected and composited to form each sample.

Review of Table 5.7 indicates that soil remaining in the areas which were scraped to remove contaminants was in fact effective for this purpose. Results from locations B2, B3, C1.1 and D2 verifies the need for removal of soil from the areas immediately to the north and east of the former structure. As noted above these areas were not scraped due the presence structural debris and the ongoing fire investigation. Therefore, the only outstanding component of soil clean-up which awaits warm weather is removal of the materials immediately to the east and north of the former structure. This work will be undertaken by means of mechanical scraping using a bobcat once spring thaw and drying permits. Materials will be tested and consigned to a chemical waste management company for disposal. Further monitoring of soils of affected areas is presently planned for summer before agricultural chemical application and in the fall at harvest time.

Figure 5.1 - Red Zone Soil Sampling Locations



## 5.3 Structure

A demolition contractor was contacted on Tuesday, November 26, 1991 to assist with the task of lifting and dissembling the remnants of the building, these primarily being the structural elements and metal siding. An initial inspection of the facility by the demolition contractor, Saskatchewan Environment and Public Safety and Saskatchewan Property Management Corporation was performed on the morning of Tuesday, November 26 to estimate the complexity of the job to follow. The demolition contractor was confident that the structural elements of the job would present no exceptional difficulties. The continuing fire investigation necessitated that as structural elements were removed, fire inspectors first be allowed to examine the exposed areas for any remaining evidence. Saskatchewan Environment and Public Safety personnel packaged chemical related debris and floor sweepings as necessary.

Demolition of the structure and repackaging of the former structure's contents began on Monday December 2, 1991 and was essentially complete by Friday December 6. Work commenced at the north end of the structure and proceeded in a stepwise manner until the entire area was addressed. The results of wipe samples collected by Environment Canada for the structural metal and materials within the building, presented in Table 5.8, were used to determine which portions required disposal by special means from those that were acceptable for recycling. The results of Microtox swab samples, presented in

Table 5.9, were also used to gain further information in this regard. Clean structural metal was removed and stacked in lay-down areas to the north and west of the building to await hauling to recyclers on December 13 and 16, 1991. The use of a steam cleaner or high pressure soap wash as suggested by Environment Canada officials for cleaning contaminated metal was rejected in favour of disposal via a chemical waste management firm due to the minus 30 degree temperatures.

**Table 5.8: Summary of Analytical Results for GC/MS Analysis of Swab Samples Collected from Structural Metal of Warehouse and Other Metallic Objects within Warehouse (All values micrograms per square meter - ug/m²)**

| Sample Nature and Location | Explanation | Compounds Present and Level |
|---|---|---|
| Surface of wall Loc. 51-18 | Moderate Dieldrin contamination | Dieldrin 850 ug/m² |
| Fallen roof panel, Loc. 78-15 | A small amount of a variety of chemicals, well below level of concern | |
| Steel tank near Loc. 68-3 | no pesticide contamination | |
| Surface of 45 Gal drum, Loc. 0-3 | no pesticide contamination | |
| Furnace surface Loc. 75-15 | Low levels of pesticide contamination, well below level of concern. | Dieldrin 319 ug/m² |
| Burned file cabinet, south end of warehouse. | no pesticide contamination | |

**Table 5.8: Summary of Analytical Results for GC/MS Analysis of Swab Samples Collected from Structural Metal of Warehouse and Other Metallic Objects within Warehouse (All values micrograms per square meter - ug/m²) (continued)**

| Sample Nature and Location | Explanation | Compounds Present and Level |
|---|---|---|
| North side of steel post, Loc. 26-10 | no pesticide contamination | |
| Surface of 45 Gal drum, Loc. 53-16 | no pesticide contamination | |
| Surface of 45 Gal drum, Loc. 7-16 | no pesticide contamination | |

It is further noted that Environment Canada officials with the Emergency Sciences Division concluded from the results of their analysis that the warehouses surfaces had pesticides on them only if visible. Additional comments noted that warehouse surfaces were generally clean except for those on the east side which were visibly contaminated. It is further postulated that fact that the fire was allow to burn without attempts to extinguish it using water assisted in so far as reducing the amount of chemical residue on the structural members following the fire. The information provided by the GC/MS analysis was supplemented by on-site testing using the Microtox system in helping to further determine which structural elements required disposal by special means and those which could be recycled through normal pathways. Structural metal requiring special treatment was removed and ultimately shipped with soil and other debris by means of a chemical waste management company for placement within a secure landfill.

**Table 5.9: Summary of Results for Microtox Bioassay of Structural Metal Swabs, December 2,1991**

| Sample | Location | Results | Sample | Location | Results |
|---|---|---|---|---|---|
| 1 | 0-0 | Non-toxic | 13 | 72-0 | Toxic |
| 2 | 6-0 | Non-toxic | 14 | 72-3 | Toxic |
| 3 | 12-0 | Non-toxic | 15 | 72-10 | Non-toxic |
| 4 | 18-0 | Non-toxic | 16 | 60-16 | Toxic |
| 5 | 24-0 | Non-toxic | 17 | 54-16 | Toxic |
| 6 | 30-0 | Non-toxic | 18 | 48-16 | Toxic |
| 7 | 36-0 | Toxic | 19 | 42-16 | Toxic |
| 8 | 42-0 | Toxic | 20 | 30-16 | Non-toxic |
| 9 | 48-0 | Toxic | 21 | 24-16 | Toxic |
| 10 | 54-0 | Toxic | 22 | 12-16 | Toxic |
| 11 | 60-0 | Toxic | 23 | 6-16 | Toxic |
| 12 | 66-0 | Non-toxic | 24 | 0-16 | Toxic |

Note: Reference point 0/0 indicates the NW corner of the warehouse, the first # indicating meters South of reference point, the second # meters East (see Figure 5.2).

Fifty-three drums of intact or recovered chemicals were packaged during the demolition and clean-up to await shipment to a chemical waste management company for disposal. Table 5.10 summarizes the materials which were found to have survived the fire intact.

**Table 5.10: Summary of Chemical Materials Found to have Survived the Fire Intact**

- 4 Labpacks of Category H reactive laboratory chemicals;
- 1 Labpack of Category J (Cyanide salts) laboratory chemicals;
- 1 labpack of radioactive ore samples;
- 14 Drums of bulked liquid pesticides;
- 4 drums of solid pesticide (can bottoms);
- 9 drums of pesticide rinsings.

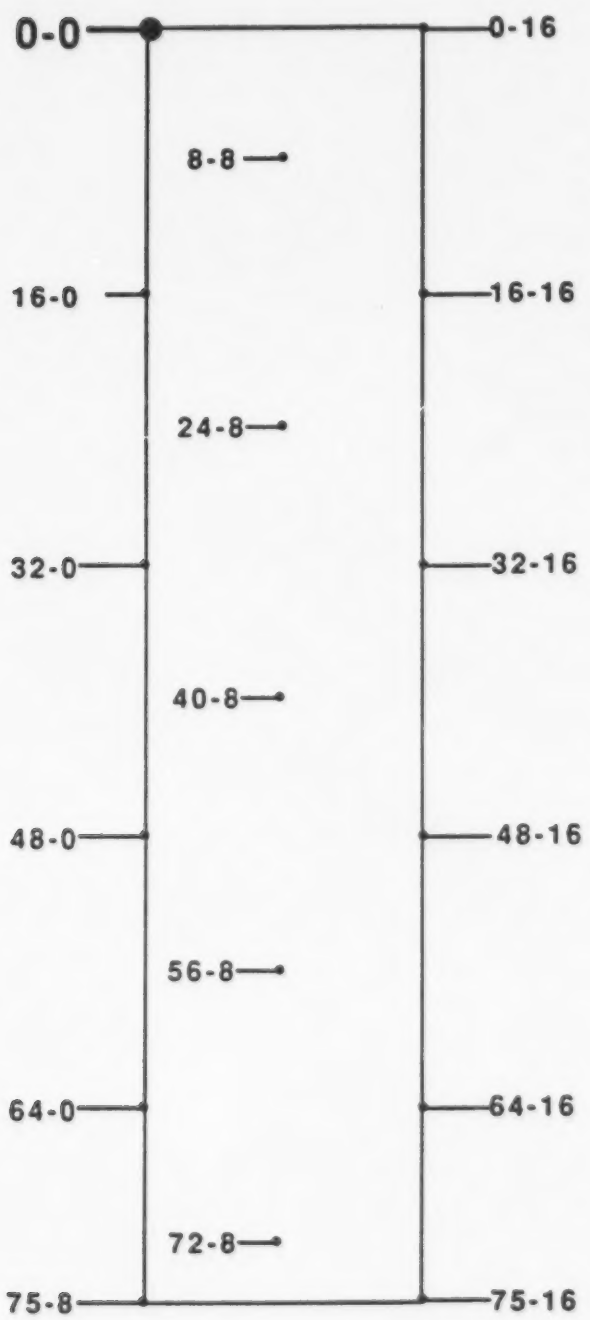
The following materials were recovered partially intact and repackaged for disposal:

- 4 drums of soda ash;
- 5 drums of hydrated lime;
- 3 drums of Avadex BW granular herbicide;
- 1 drum of paint related material;
- 4 drums of pesticide sludge, partially burned pesticide materials and contaminated containers;
- 3 drums of contaminated floor sweepings.

The above noted 53 drums of material which were repackaged and shipped for disposal by means of a chemical waste management company on December 16, 1991. Additionally approximately 100 drums of non-contaminated vermiculite was recovered and placed in storage for future use.

During the clean-up of the structure, materials which remained after the removal of the structural metal and surviving chemicals was swept up and placed within 45 gallon drums to await sampling and decision regarding disposal. Approximately 260 drums of floor sweepings, comprised of insulation, wood, wood ash, small metal parts, gyproc and snow were generated and packaged apart from the known chemical containing remains. Generally, these materials were suspected of containing low levels of pesticide contamination, this conclusion being verified by GC/MS analysis of samples of this material when it was still in place on the floor of the former structure. Table 11 presents the results of GC/MS analysis of warehouse ash collected during initial warehouse assessment performed by Environment Canada. The

# Figure 5.2 - Transfer Station Reference Points




North

1cm ~ 4 m

**Reference Points**

**0-0** indicates the northwest corner of structure. The first number indicates meters south of reference point, the second number indicates meters east of reference point.

results of additional samples collected during clean-up for analysis by means of the Microtox system are presented in Table 12.

**Table 5.11: Summary of Analytical Results for Analysis of Ash Samples Collected from the Warehouse Floor. (All values Parts per Million unless otherwise noted)**

| Sample Nature and Location | Explanation | Compounds Present and Level |
|---|---|---|
| Ash and debris on warehouse floor, composite of about 10 locations. | Low levels of pesticide contamination, well below level of concern | Triallate 0.4 ppm<br>2,4-D 0.8 ppm |
| Composite ash samples from Locs. 11-16 and 15-16 | Low levels of dioxins and dibenzofurans, typical of combustion residue, the level is not of concern. | Total PCDD 0.099 ng/g<br>Total PCDF 0.641 ng/g |
| Ash and debris on warehouse floor, Loc. 75-[illegible]4 | Low levels of pesticide contamination, well below level of concern | Triallate 0.3 ppm<br>2,4-D 1 ppm |
| Ash and debris on foundation wall, Loc. 18-16 | Low levels of pesticide contamination, well below level of concern | Dichloro-phenol ppb levels |
| Ash and debris on warehouse floor, Loc 0-16 | High level of Heptachlor low levels of other pesticides well below level of concern | Heptachlor 356 ppm<br>Chlordane ppb's<br>nitro-phenol compound ppm |

**Table 5.12: Summary of Microtox Bioassay Results of Ash Samples Collected During Clean-up, December 6, 1991**

| Sample | Result |
|---|---|
| 1 | Very Toxic |
| 2 | Toxic |
| 3 | Non-toxic |

Note: Preliminary floor sweeping samples from warehouse (during cleanup) were collected using a spatula to obtain a 500 gm sample of ash and snow.

The various results presented in Tables 5.10 through 5.12 indicate that the floor sweeping debris was contaminated to varying degrees. It is postulated that the degree of contamination detected is dependant on the location from which the sample was collected and most likely depends on the proximity to chemicals stored within the warehouse or however the ash may have been exposed to chemical during the progress of the fire. As a result of the non-homogeneous nature of the floor sweepings, it was sampled further once contained within the 260 - 45 gallon drums to aid in deciding the required disposal process. Samples were collected from 30 if the 260 drums, in relatively equal proportions as to their source from within the warehouse. The results of both Microtox and discrete chemical and constituent analyses are presented in Tables 5.13 and 5.14 respectively.

**Table 5.13: Summary of Results of Microtox Bioassay of Warehouse Floor Sweepings Collected from Containment Drums, December 9, 1991.**

| Sample | Result | Sample | Result | Sample | Result |
|---|---|---|---|---|---|
| Comp.B | Very Tox. | Comp. M | Very Tox. | Comp. F | Toxic |
| B8 | Non-toxic | M7 | Very Tox. | F2 | Toxic |
| B14 | Toxic | M19 | Toxic | F14 | Very Tox. |
| B15 | Non-toxic | M27 | Toxic | F18 | Toxic |
| B26 | Toxic | M43 | Very Tox. | F47 | Toxic |
| B39 | Very Tox. | M47 | Non-toxic | F54 | Very Tox. |
| B48 | Toxic | M55 | Non-toxic | F66 | Toxic |
| B69 | Toxic | M61 | Very Tox. | F75 | Toxic |
| B71 | Toxic | M67 | Toxic | F84 | Very Tox. |
| B77 | Non-toxic | | | F87 | Toxic |
| | | | | F91 | Toxic |
| | | | | F97 | Toxic |
| | | | | F109 | Very Toxic |
| | | | | F113 | Very Toxic |

Note: Floor sweeping samples from drums (after cleanup). 260 drums were accumulated, 79 labelled B (back), 68 labelled M (middle) and 113 labelled F (front) indicating approximately were they were filled. Using a spatula, a 500 gm sample was collected from the above-noted drums. Composites were also submitted for Microtox analysis from the each of the Front, Middle and Back series of drums. Samples from all drums were randomly selected.

**Table 5.14: Summary of Analytical Results of Pesticide and Constituent Analyses of Warehouse Floor Sweepings Collected from Containment Drums, December 18, 1991.**

Pesticides µg/g (ppm)

| GLC Analytes | replicate 1 | replicate 2 |
|---|---|---|
| 2,4-D | 1.3 | 870 |
| Heptachlor | 0.3 | <0.1 |
| Triallate | 6 | 38 |
| Trifluralin | <0.1 | <0.1 |
| DDT | <0.1 | <0.1 |

**Table 5.14: Summary of Analytical Results of Pesticide and Constituent Analyses of Warehouse Floor Sweepings Collected from Containment Drums, December 18, 1991. (continued)**

| | | |
|---|---|---|
| **Major Constituents(%)** | | |
| Carbon | 9.7 | 15.0 |
| Carbon (inorganic) | 0.51 | 0.43 |
| Carbon (organic) | 9.19 | 14.6 |
| **Trace Constituents(ug/g)** | | |
| GLC Analytes | replicate 1 | replicate 2 |
| Boron | 350 | 920 |
| Mercury | 0.18 | 0.19 |
| Phosphorous | 910 | 310 |
| Selenium | 0.4 | 0.5 |
| **Trace Metals(ug/g)** | | |
| Silver | <1 | <1 |
| Aluminum | 15,000 | 18,000 |
| Arsenic | 5.7 | 4.2 |
| Barium | 120 | 180 |
| Beryllium | 2 | 2 |
| Calcium | 180,000 | 180,000 |
| Cadmium | 2 | 2 |
| Cobalt | 5 | 8 |
| Chromium | 77 | 74 |
| Copper | 240 | 200 |
| Iron | 8,700 | 8,900 |
| Potassium | 1,900 | 2,400 |
| Magnesium | 15,000 | 18,000 |
| Manganese | 550 | 700 |
| Molybdenum | <4 | 12 |
| Sodium | 4,800 | 8,600 |
| Nickel | 7 | 8 |
| Lead | 31 | 43 |
| Titanium | 970 | 1,000 |
| Vanadium | 22 | 34 |
| Tungsten | 34 | 46 |
| Zinc | 1,800 | 2,400 |

**Table 5.14: Summary of Analytical Results of Pesticide and Constituent Analyses of Warehouse Floor Sweepings Collected from Containment Drums, December 18, 1991. (continued)**

EPA Leachate Extraction(ug/L)

| Analyte | replicate 1 | replicate 2 |
|---|---|---|
| 2,4-D | <1.0 | 1,100 |
| Heptachlor | <0.1 | <0.1 |
| Triallate | 8 | 55 |
| Trifluralin | <0.1 | <0.1 |
| DDT | <0.1 | <0.1 |

Note: The above-noted floor sweeping samples from above were analyzed by Saskatchewan Research Council. These samples were a portion of the same samples collected for the purposes of Microtox analysis as outlined for Table 5.13

From the above noted information it is apparent that actual pesticide concentrations are relatively low although the ash material was relatively toxic for most of the individual drums sampled. As a result of the high incidence of toxic samples and the fact that the material just fails the 2,4-D EPA leachate extraction criteria for acceptance within municipal landfills, it was decided to consign the floor sweepings contained within the 260 drums to a chemical waste management company for placement within a secure landfill. This material was subsequently shipped along with contaminated soil by means of bulk waste transport according to the requirements of the Transportation of Dangerous Goods Regulations on February 25 and March 12, 1992.

The majority of pressing on-site clean-up activities of the structure were

completed as of December 17, 1991. In terms of clean-up remaining, as the majority of the clean-up activities at the site are completed, the remaining foundation and floor will require treatment to remove or destroy any remaining surface contamination. This tasks will are scheduled for completion during spring months.

## 5.4 Shed

Clean-up of the interior of the shed immediately south-east and adjacent to the former structure was completed by December 6, 1991 by means of the services of an industrial cleaning company. This was be accomplished first by using high efficiency vacuum cleaners followed by industrial soap washes. Power and gas was re-established to the building thereafter so that it could be heated.

Samples and analytical results for this portion of the clean-up consisted of wipes for Microtox analysis both during and following cleaning activities. Results of these samples are presented in Tables 5.15 and 5.16.

**Table 5.15: Summary of Results of Microtox Bioassays of Samples Collected During Clean-up Activities from Inside of Shed, December 3, 1991.**

| Sample # - Location | Results |
|---|---|
| 1 - Table saw | Non-toxic |
| 2 - Outside of fridge | Toxic |
| 3 - Filing cabinet, W wall | Toxic |
| 4 - Spray washer | Toxic |
| 5 - Vacuum cleaner | Non-toxic |
| 6 - Pump | Non-toxic |
| 7 - Floor, E side | Toxic |
| 8 - Outside, cabinet, E wall | Non-toxic |
| 9 - Inside, cabinet, E wall | Non-toxic |
| 10 - Blank | Non-toxic |
| 11 - Ceiling lights, N side | Toxic |
| 12 - Top of desk | Non-toxic |
| 13 - Blank | Non-toxic |

**Table 5.16: Summary of Microtox Bioassays of Samples Collected Following Clean-up Activities from Inside of Shed, December 6, 1991**

| Sample # - Location | Results |
|---|---|
| 1 - Top desk & top drawer | Non-toxic |
| 2 - Telephone (office) | Non-toxic |
| 3 - Window (office) | Non-toxic |
| 4 - T.V. (office) | Non-toxic |
| 5 - Toilet & sink | Non-toxic |
| 6 - Shower | Non-toxic |
| 7 - Window (washroom) | Non-toxic |
| 8 - Floor (office & washroom) | Non-toxic |
| 9 - Tool box, E wall | Non-toxic |
| 10 - Windows on garage door | Non-toxic |
| 11 - Stereo & records | Non-toxic |
| 12 - Furnace | Toxic |
| 13 - Fridge inside & contents | Non-toxic |
| 14 - Moisture meter | Non-toxic |
| 15 - Glass jars, E wall | Non-toxic |
| 16 - Floor in garage area | Non-toxic |
| 17 - Door knobs | Non-toxic |

Results of Table 5.15 indicate that some toxic remnants were present within the shed following the fire. It is not directly evident however, if these were the result of the fire or due the presence of other compounds prior to the event. Results of a swab taken from Mr. Perrault's desk within the shed performed by Environment Canada officials immediately following the fire shows that pesticides were not deposited on the surface of the desk as a result of the fire and that levels of PCDD's and PCDF's were below usual background levels (Table 5.17). It is therefore evident that positive tests from within the shed were the result of pre-existing material. It was noted during the cleanup that most unused surfaces were very dusty. In any event the results of wipes performed after the interior cleanup indicate that the interior of the shed was free of toxic residues.

With respect to the exterior of the shed samples collected and analyzed by Environment Canada following the fire are presented in Table 5.17. These results suggest that moderate to high levels of pesticides were present, likely a result of spray ejected from containers which BLEVE'd during the fire. Since extraction of the pesticides form the unpainted surface of the shed was virtually impossible, it was necessary to remove and replace the plywood siding, shingles, facia, door, door frame and eaves of the building on the west and north sides. Contractors were engaged in replacing siding and shingles from Mr. Perrault's shed adjacent to the former warehouse. This work generated approximately 25

drums of contaminated waste and was completed by early in the January, 1992. These wastes were bulked and shipped to a secure landfill in conjunction with soil and floor sweepings generated during other clean-up activities.

**Table 5.17: Summary of Analytical Results of Swab Samples Collected from the Adjacent Shed.**

Outside Shed Wall (North Wall)

| | |
|---|---|
| 2,4-D | 16,560 ug/m$^2$ |
| Triallate | 195 ug/m$^2$ |
| 2,4,5-T | 649 ug/m$^2$ |
| DDT | 52,600 ug/m$^2$ |

Outside Shed Wall (West Wall)

| | |
|---|---|
| 2,4-D | 4,170 ug/m$^2$ |
| Triallate | 73 ug/m$^2$ |
| DDT/DDD | 1,540 ug/m$^2$ |

Desk in office, inside Ron Perrault's Shop

No pesticide contamination

Cabinet, office inside Ron Perrault's Shop

| | |
|---|---|
| Total PCDD | 1.6 ng/m$^2$ |
| Total PCDF | 12.7 ng/m$^2$ |

very low levels of dioxins or dibenzofurans, below usual background levels.

## 5.5 Contractor's Heavy Equipment

As a result of the need to employ heavy equipment to both remove soil and demolish the former building, it was necessary to test the equipment before

allowing it to move off-site. The equipment was first cleaned and then sampled using swap wipes for Microtox analysis as a method to detect any remaining contamination. Equipment was first cleaned using hand tools, brooms and wiping rags to remove remnants of contaminated soil and other debris. Following the cleaning, wipes of the equipment were taken primarily from locations which were exposed to soil or to which equipment operators would most often be in contact with. Table 5.18 through 5.22 summarize the results of numerous analyses performed on sample taken from the contractor's equipment.

**Table 5.18: Summary of Results of Microtox Bioassay of Samples Collected from the Highways Road Sweeper, November 28, 1991.**

| Sample # - Location | Results | Sample # - Location | Results |
|---|---|---|---|
| 1 - Brush | Toxic | 6 - Front | Toxic |
| 2 - Housing | Toxic | 7 - Bucket | Toxic |
| 3 - Tractor Tires | Toxic | 8 - Right Beam | Toxic |
| 4 - Right Side | Toxic | 9 - Blank | Non-toxic |
| 5 - Tires | Toxic | | |

Note: Kim-Wipes (wipe medium) gave readings high enough to mask the actual toxicity associated with any possible remaining contaminants on the machinery. As a result, cotton batten was used for subsequent wipes (see Table 5.23: Determining a Proper Medium For Wipes) and the sweeper was re-sampled.

**Table 5.19: Summary of Results of Microtox Bioassay of Samples Collected from the Highways Road Sweeper, December 2, 1991.**

| Sample # - Location | Results | Sample # - Location | Results |
|---|---|---|---|
| 1 - Rear Left Tire | Non-toxic | 3 - Brush Cowl | Non-toxic |
| 2 - Engine Cowl | Non-toxic | 4 - Brush | Non-toxic |

**Table 5.20: Summary of Results of Microtox Bioassay of Samples Collected from the Contractor's Bulldozer, December 3, 1991.**

| Sample # - Location | Results | Sample # - Location | Results |
|---|---|---|---|
| 1 - Arm Rests* | Non-toxic | 6 - Track | Non-toxic |
| 2 - Rear & Side Windows* | Non-toxic | 7 - Track Wheel | Non-toxic |
| 3 - Hand Controls & Dash* | Non-toxic | 8 - Inside Bucket | Non-toxic |
| 4 - Ceiling* | Non-toxic | 9 - Outside Bucket | Non-toxic |
| 5 - Door Panels* | Non-toxic | 10 - Bucket Teeth | Non-toxic |

* - Denotes wipes inside cab.

**Table 5.21: Summary of Results of Microtox Bioassay of Samples Collected from the Contractor's Back-hoe, December 12, 1991.**

| Sample # - Location | Results | Sample # - Location | Results |
|---|---|---|---|
| 1 - Hoe(inside) | Non-toxic | 6 - Window(front) | Non-toxic |
| 2 - Hoe(outside) | Non-toxic | 7 - Inside Bucket | Non-toxic |
| 3 - Tires(front) | Non-toxic | 8 - Outside Bucket | Non-toxic |
| 4 - Tires(back) | Non-toxic | 9 - Window(front & back)* | Non-toxic |
| 5 - Stabilizers | Non-toxic | 10 - Hand Controls & Dash* | Non-toxic |

* - Denotes wipes inside cab.

**Table 5.22: Summary of Results of Microtox Analytical of Samples Collected from the Contractor's Bobcat, December 12, 1991.**

| Sample # - Location | Results | Sample # - Location | Results |
|---|---|---|---|
| 1 - Tires Front (solid) | Non-toxic | 7 - Bucket (top) | Non-toxic |
| 2 - Tires Front (solid) | Non-toxic | 8 - Grapple | Non-toxic |
| 3 - Bucket (bottom ) | Non-toxic | 9 - Hand Controls & Dash* | Non-toxic |
| 4 - Bucket (side) | Non-toxic | 10 - Safety Bar* | Non-toxic |
| 5 - Bucket (teeth) | Non-toxic | 11 - Back Window* | Non-toxic |
| 6 - Bucket (inside) | Non-toxic | 12 - Tires(air inflated) | Non-toxic |

* - Denotes wipes inside cab.

**Table 5.23: Determining a Proper Medium For Wipes, November 28, 1991.**

| Medium | Results |
|---|---|
| Kim-Wipes | Toxic (44/88) |
| Cotton Balls | Toxic (37/94) |
| Q-Tips | Non-Toxic (45/85) |
| Cotton Batten* | Non-toxic (56/88) |
| Filter Paper | Non-toxic (49/97) |
| Linen | Toxic (35/89) |
| Empty Vial | Non-toxic (58/88) |

Note: Kim-wipes gave a 44/88 light reduction, or right at the point of demarkation between a toxic and non-toxic sample. Therefore, any cumulative affects imparted on a sample during the swapping of the machinery in question would not be discernable and necessitated the selection of another media for collecting samples. Cotton Batten was subsequently selected as the best medium for collecting wipes because it gave the least light reduction during sampling.

Once a adequate medium for determining any remaining toxicity was determined, it was apparent that cleaning methodologies were adequate to remove any contamination remaining on the machinery.

## 5.6 Run-off

A small amount of contaminated run-off was generated as a result of snow-melt along the area immediately adjacent to the east side of the former structure during March of 1992. As previously noted, contaminated soil was not removed from this area during the late fall months due to the proximity of structural debris and the ongoing fire investigation. The identity of chemicals within the surfacial soil along the eastern edge of the former structure was determined by Environment Canada during initial sampling following the fire

and are presented in Table 5.24.

**Table 5.24: Summary of Analytical Results for Pesticides within Surficial Soils - Immediately East of the Former Transfer Station.**

| Sample Nature and Location | Explanation | Compounds Present and Level | |
|---|---|---|---|
| Soil just outside east wall. Loc 33-16 | High level of 2,4-D low levels of other pesticides. | 2,4-D | 8600 ppm |
| "Pink" soil splattered with chems. just east of building | Moderate pesticide contamination. | 2,4-D<br>Heptachlor<br>Chlordane | 2140 ppm<br>3470 ppm<br>1560 ppm |
| Yellowish residue just east of warehouse Loc. 30-18. | Very low levels of dioxins or dibenzo-furans | Total PCDD<br>Total PCDF | 0 ng/g<br>0 ng/g |
| Uncontaminated soil upwind of ware-house (control) | Very low levels of dioxins or dibenzo-furans | Total PCDD<br>Total PCDF | 0 ng/g<br>0 ng/g |
| Red-pink soil just east of warehouse near Loc. 15-22. | low levels of dioxins and dibenzofurans, below usual background levels. | Total PCDD<br>Total PCDF | 0.38 ng/g<br>5.8 ng/g |
| Blank - Method blank | Test run to determine method validity. | Total PCDD<br>Total PCDF | 0 ng/g<br>0 ng/g |

Subsequently, approximately 15,000 litres of run-off water contaminated with 2,4-D and Heptachlor was collected and placed within 45 gallon drums for treatment. Treatment of the water employed Granular Activated Carbon and Fibreglass filtration to remove dissolved pesticides and particulates. Samples of

both the contaminated water and treated water were collected and analyzed for both discrete pesticide compounds and dissolved organic carbon and are presented in Table 25. Dissolved Organic Carbon was the parameter employed to determine the degree of efficacy for each of the 75 barrels of treated water (Table 26) because of the complexity and high cost of discrete chemical analysis. Further plans call for the discharging the treated water to the farm field west of the former structure once treatment and testing has been completed.

**Table 5.25: Summary of Analytical Results for Contaminated and Treated Run-off Water.**

| Parameter | Contaminated Run-off | Treated Run-off | Water Quality Max. Accept Conc. |
|---|---|---|---|
| 2,4-D | 2300 ug/L | 2.9 ug/L | 0.1 mg/L |
| Triallate | 30 ug/L | 0.24 ug/L | 0.23 mg/L |
| Trifluralin | 0.1 ug/L | <0.05 ug/L | 0.045 mg/L |
| Heptachlor | <0.05 ug/L | <0.05 ug/L | 0.003 mg/L |
| D.O.C.* | 51 mg/L | 13 mg/L | ---- |
| pH | 8.3 | 8.4 | 6.5-9.0 AO* |
| Cond. | 1,980 uS/cm | 2,020 uS/cm | ---- |

*Note: D.O.C means Dissolved Organic Carbon
AO means Aesthetic Objective

**Table 5.26: Summary of Analytical Results of Treated Run-off Water (All values parts per million).**

| Barrel # | D.O.C. | Barrel # | D.O.C. |
|---|---|---|---|
| 1 | 7 mg/L | 2 | 6 mg/L |
| 3 | 6 mg/L | 4 | 6 mg/L |
| 5 | 5 mg/L | 6 | 4 mg/L |
| 7 | 10 mg/L | 8 | 7 mg/L |
| 9 | 3 mg/L | 10 | 5 mg/L |
| 11 | 3 mg/L | 12 | 4 mg/L |
| 13 | 5 mg/L | 14 | 4 mg/L |
| 15 | 3 mg/L | 16 | 4 mg/L |
| 17 | 4 mg/L | 18 | 4 mg/L |
| 19 | 3 mg/L | 20 | 5 mg/L |

Note: Sample #20 was actually a control sample taken from a drinking water tap.

Expenditures for the actual clean-up to the end of March, 1992, are estimated at $150,026.00. However, this figure includes $23,975 for disposal of ICCP chemicals remaining after the fire, which would have to be disposed of regardless of whether a fire occurred or not, and an investment of $23,957 in drums used during the clean-up, but which have been retained by the Department for future use.

## 5.7 Conclusions and Recommendations

Clean-up activities of the former Grand Coulee transfer facility included removal and disposal of contaminated soil, demolition and disposal of the building structure, packaging and shipment of surviving chemicals, packaging and disposal of ash and small debris, remediation of the adjacent storage shed

and collection and treatment of a small volume of contaminated snow-melt. The pressing site clean-up and containment was successfully completed by December 17, 1991 and the remainder of the associated waste shipment or treatment being completed by late March, 1992.

The results of various analyses performed both immediately after the fire or during the clean-up of the Grand Coulee transfer site were valuable in determining the degree of contamination and the appropriate disposal mechanism for the remnants of the former operation. Analysis of soil samples showed that contamination was confined to an area immediately to the south-east of the former structure and that clean-up measures employed to deal with these residues were effective.

In terms of the transfer facility structure itself, it is generally concluded that considering the volume of chemicals on-hand at the time of the fire, remnants of the building were not heavily contaminated. It is further postulated that fact that the fire was allow to burn without attempts to extinguish it using water assisted in so far as reducing the amount of chemical residue on the structural members following the fire.

Removal of a small area of contaminated soils from along the eastern edge of the former structure is scheduled for the first dry opportunity during early

spring periods. Soil from this area could not be removed previously because of the presence of structural debris and ongoing fire investigations at the time. Monitoring of soils in the affected areas is recommended to reconfirm the adequacy of clean-up and previous monitoring results. The only remaining component of the clean-up of the structure to be addressed is a final treatment of the concrete floor and foundation to remove or destroy any remaining surface contamination. It is recommended that this work be performed as soon as spring weather permits.

The following specific conclusions are also drawn from the clean-up activities and the associated analytical results:

1. The results lend evidence that NW to NNW winds during the fire event, were the primarily governing factor which directed dispersal of sprayed chemicals lofted into the air due to BLEVE'd containers;
2. Fifty-three drums of intact or partially intact chemicals were recovered during the demolition and clean-up operation; and
3. Treatment of contaminated snow-melt water which employed Granular Activated Carbon and Fibreglass filtration was effective in the removal of both dissolved pesticides and particulates.

## 6.0 INDEPENDENT STUDY OF THE AGRICULTURAL CHEMICAL COLLECTION PROGRAM

6.1 One of the directions received from the Minister was to:

> *"Evaluate the Agricultural Chemical Collection Program, to see if the collection, transportation and storage of waste chemicals is being done in the best possible manner."*

6.2 The Department entered into an agreement with William Neff of William A. Neff Consulting Inc. of Ottawa to carry out the required study. Mr. Neff has had a wide range of experience including five and a half years as Division Chief, Petroleum and Organic Chemicals, Environmental Protection Division, Environment Canada and twelve years as Vice-President, Technical Affairs of the Canadian Chemical Producers Association. Mr. Neff is a graduate of the University of Saskatchewan (1959) with a degree in Chemical Engineering.

6.3 Mr. Neff's study was received by the Department in early March, 1991. A copy of the Executive Summary of the report containing the Conclusions and Recommendations is provided in the following section. The main conclusion of the Report was, "The Agricultural Chemical and Institutional Chemical Collection Programs are worthwhile and meet a demonstrated environmental need." However, the Report raised a number of concerns related to policy considerations and operational details.

## 6.4 Executive Summary

On November 20, 1991 a fire destroyed a warehouse, leased by the Saskatchewan Government for use as a transfer station for unusable pesticides and institutional wastes near the Village of Grand Coulee. On November 29, 1991, an internal Board of Review tabled its interim report. At the same time the Board appointed an independent consultant, to undertake a study into the storage, handling and transportation of waste chemicals in Saskatchewan and submit a report, summarizing the assessment and setting out conclusions and recommendations.

The approach followed was to determine what represented "Good Current Practice" for operations similar to the Grand Coulee warehouse, as carried out or recommended by other provincial jurisdictions in Canada (Alberta and Ontario) and responsible sectors of industry. These findings were then compared with the Grand Coulee operation and recommendations were developed to address any apparent deficiencies.

"Good current practice" was defined to include elements and principles relating to:

- Role of Management and Overall Policy
- Design and Construction Aspects
- Modifications to Plant or Process
- Safe Plant Operations/Standing Orders
- Occupational Health and Safety
- Security
- Maintenance Programs
- Operational Aspects including Identification, Classification, Segregation, Operating Procedures, and Training
- Record Keeping including Inventories of Materials
- Emergency Preparedness
- Community Awareness and Emergency Response

It is recognized that not all of these sources and information are directly applicable to the current chemical collection programs operating in Saskatchewan or the situation at the Grand Coulee warehouse. The principles contained in them however, are relevant in evaluating whether the current programs and processes, including the methods of storage in Saskatchewan, were being done in the best possible manner. It is hoped that the information contained in the Appendices can be used as a starting point to facilitate the upgrading of certain elements of the program found to be deficient.

In carrying out this assessment the focus was on the process and policy framework that was in place, rather than on the specific incident itself. The objective was to assess the overall program, to identify deficiencies, and make recommendations that would assist in building a new and improved program.

Following a careful assessment of the documents and comments provided by officials of Saskatchewan Environment and Public Safety and comparing them to what was defined as "Good Current Practice" a number of deficiencies were identified, some of them serious. These are set out in the following section. Details are given in the body of the report.

The costs of collecting and disposing of hazardous wastes in Saskatchewan compares favourably with similar costs in Ontario and Alberta when discounted for the higher transportation costs that Saskatchewan must pay to ensure their proper disposal.

## CONCLUSIONS

1. The Agricultural Chemical and Institutional Chemical Collection Programs are worthwhile and meet a demonstrated environmental need.

2. As a result of the assessments carried out deficiencies have been identified in the following general areas. Details are given in the body of the report:

**Role of Management and Overall Policy including:**

- Delegation of Responsibilities the Third Parties
- Responsiveness and Control of Operations
- Maintenance of an Arms' Length Relationship with Regulators
- Documentation of Decisions and Standards

**Design and Operational Aspects**

Partial conformance with the Crop Protection Institute of Canada's (CPIC's) Warehouse Standards was identified in the following areas:

- access to facility
- design specifications for storage and loading areas
- ventilation of building
- lighting of storage facility
- electrical installations and equipment
- protection from intruders and vandalism
- risk control/minimization/elimination: training
- Workplace Hazardous Materials Information System (WHMIS)
- damaged goods in storage
- operating procedures - hazard identification
- inspection of material on receipt
- product inventory records
- product inventory and product movement records
- incompatible products - product segregation
- flammable products - product segregation
- open flames, smoking and eating
- occupational health and safety
- new employee induction
- identify and understand the hazardous nature of a product
- emergency procedures
- recording of training and training certificates
- loading and unloading procedures

In many cases a partial conformance rating was given because of the total lack of written operating procedures and the lack of regular and formalized training. Verbal communication was relied upon almost totally.

Lack of conformance with the CPIC Warehouse Standards was identified in the following areas:

- building, fire and electric codes
- fire walls, fire doors and windows
- heating installation
- electrical installations
- open flames in storage area
- automatic sprinkler system
- fire detection system
- pre-fire plans - emergency procedures
- signs and warnings
- access to emergency services
- operating procedures

Additional comments were provided on the following aspects:

- Identification, Classification and Segregation including labpacking and the bulking process
- Occupational Health and Safety Considerations
- Documented Procedures, Training and Record Keeping
- Inventories of Materials
- Open Flames
- Modifications to Plant or Process
- Emergency Preparedness, Community Awareness and Emergency Response

Of all of these, the role of management and overall policy is considered the most important since, if this deficiency were rectified, the other shortcomings would tend to fix themselves.

3. Adjusted costs, to collect and dispose of unusable pesticides in Saskatchewan, are essentially the same as costs for similar operations in both Alberta and Ontario.

   This is significant since both Alberta and Ontario rely on contractors to collect their wastes and do not practice bulking. In Saskatchewan, waste pesticides were collected by Department staff and the process of bulking was practised.

4. There is reason to believe that, to date, only a relatively small proportion of waste and unusable pesticides in Saskatchewan have been collected and destroyed.

5. The Hazardous Substances Regulations and proposed amendments do not adequately consider the effect that a change in chemical composition within a storage facility may have on the integrity of the operation.

## RECOMMENDATIONS

1. The Agricultural Chemical and Industrial Chemical Collection Programs should be maintained in some form.

2. The National Fire Code should be adopted for all of Saskatchewan or applied to any future pesticide warehouses.

3. Reactive and institutional wastes should not be stored in the same open area as flammable materials and pesticides.

4. The process of bulking liquid pesticide wastes should be discontinued until such time as written criteria are established which have been independently reviewed and accepted.

5. Saskatchewan Environment and Public Safety should maintain an arm's length position from any future chemical collection programs. Possible options include contracting out (short term) or establishing a Crown corporation (longer term).

6. Saskatchewan Environment and Public Safety should develop a long term integrated strategy to deal with waste pesticides, institutional and household wastes in a cost effective manner.

7. The definition of "alteration" in the Hazardous Substance Regulations should be broadened to include "any significant change in the chemicals contained within a storage facility."

6.5 Specific recommendations based on Mr. Neff's report are contained in Section 7.0.

## 7.0 RECOMMENDATIONS

**7.1 It is recommended that the Province adopt and enforce the National Fire Code of Canada.**

7.2 The National Fire Code addresses the importance of environmental issues and safety standards underlying the use of special facilities for both the storage and transfer of new and used chemicals and hazardous substances including wastes and flammable materials. **It is recommended that the location of such sites be established in accordance with set criteria with consideration for risk to people, property and the environment.** This should be done in consultation with Saskatchewan Environment and Public Safety. As well the Crop Protection Institute of Canada Warehousing Standards provides recommendations for siting such facilities which can be used as guidelines. These facilities must also be constructed and maintained in accordance with The National Building Code of Canada. Plans for new facilities and alterations to existing facilities should be approved by the authority having jurisdiction and submitted to the Fire Commissioner for review.

**7.3 Saskatchewan Environment and Public Safety should develop a long term strategy to deal with waste pesticides, institutional and household wastes. This must be done as part of the development of an overall waste management strategy for the province which should be initiated as soon as possible.**

7.4 **It is recommended that the existing Hazardous Substances Regulations be amended immediately to include the storage and safe disposal of hazardous wastes.**

7.5 **The Agricultural Chemical Collection Program and the Institutional Chemical Collection Program should be maintained, however, the programs should be deferred for at least one year to allow for a suitable site to be selected and developed.** It should be noted that a new site will have to satisfy the requirements of the Environmental Assessment Act as well as all regulations applicable to hazardous wastes.

7.6 **Saskatchewan Environment and Public Safety should review its present relationship to these chemical collection programs.** Any involvement in the future should be as the regulator and not as the program manager. At the same time, the Department should also review the funding of these programs with a view to recovering the costs from the users of the chemicals.

7.7 **It is recommended that a provincial emergency response team be established to deal with incidents of similar nature in the future.** This would require initial and ongoing training for the response team, supported with equipment that would allow them to respond to a variety of incidents. It is recommended this training be provided in accordance with NFPA 471 Recommended Practice for

Responding to Hazardous Materials Incidents. This standard outlines the minimum requirements for dealing with responses to hazardous materials incidents and provides specific operating guidelines.

7.8 It is recommended that all levels of government: federal, provincial, and municipal, work together with industry and organizations such as MIACC (Major Industrial Accident Coordination Committee) to strengthen relationships and ensure the most effective response is provided when needed. **It is further recommended that the province establish a provincial coordinating committee to develop response plans and procedures for effective emergency response.**

7.9 **It is also recommended that the Government of Saskatchewan develop its own emergency response communication strategy to deliver and provide information when incidents similar to this one involve government departments.** The control and planned release of accurate information is very important. This was very effective in the days following the incident however the process on the day of the incident appeared inadequate.

**The feasibility of an emergency 1-800 number or province wide 911 system should be investigated.** This would allow for the notification of all agencies and personnel who have a response role or a vested interest in an incident of any

nature.

7.10 **It is recommended that training be made available to all emergency responders who could be called upon to deal with hazardous materials incidents.** This training should meet as a minimum the requirements outlined in the National Fire Protection Association Standard 472, Professional Competence of Responders to Hazardous Material Incidents.

7.11 **It is recommended that the local authority having jurisdiction, must ensure these facilities are inspected regularly and all codes are enforced.** All locations, where dangerous goods are stored, must be identified and response plans provided to the local fire department. This will provide the **"Right to Know"** for members of the community as well as support preparation of the overall community response plan. It is recommended that an inventory of all hazardous material sites be established and that regular inspection cycles be maintained. Response plans must be provided to the local fire department in accordance with The National Fire Code. It should be the role of the Provincial Fire Commissioner's Office to audit inspections of these facilities.

7.12 Restricted access to and from hazardous material sites and security of products stored there is critical to the safe operation of such facilities. **It is recommended that physical security, including locks, fences and access and inventory control**

**be maintained at all hazardous material storage locations.**

7.13 The Crop Protection Institute of Canada has developed "Warehousing Standards" for the storage of crop protection products for agricultural use and storage of pesticides for industrial use. **It is recommended that all facilities be constructed, managed and operated in accordance with these standards or equivalent provincial standards.**

7.14 **The process of bulking liquid pesticide wastes should be discontinued until such time as written criteria are established which have been independently reviewed and accepted.**

7.15 **The Saskatchewan Emergency Measures Organization should assist communities such as Grand Coulee develop and implement an emergency response plan.** These plans should include a communication strategy that would ensure the notification of residents and the safety of all responders and should be tested on an annual basis.

7.16 **It is recommended that further monitoring of soils in the affected areas be completed to confirm previous monitoring results.**

**7.17 It is recommended that a final treatment of the foundation and floor area be completed as soon as possible and the adequacy of the treatment be confirmed by monitoring.**

## 8.0 APPENDICES

The following Appendices contain information used in the completion of the Investigation.

| | |
|---|---|
| Appendix A | Fire Safety Plan |
| Appendix B | Grand Coulee Chemical Warehouse Fire - Analytical Methodology |
| Appendix C | Microtox General Information |
| Appendix D | Microtox Operating Procedure |
| Appendix E | Environment Canada Gas Chromatograph/Mass Spectroscopy Analytical Results |
| Appendix F | Building Layout Diagram |
| Appendix G | Preliminary Site Assessment - Grand Coulee Chemical Facility (Merv Fingas - Environment Canada) |
| Appendix H | An Assessment of Saskatchewan's Waste Chemical Collection Programs (W. Neff Consulting Inc.) |

Due to the volume of this information the Appendices were not reproduced as part of the report. A copy of these Appendices is available in the library of Saskatchewan Environment and Public Safety, Room 126, 3085 Albert Street, Regina, Saskatchewan, S4S 0B1.